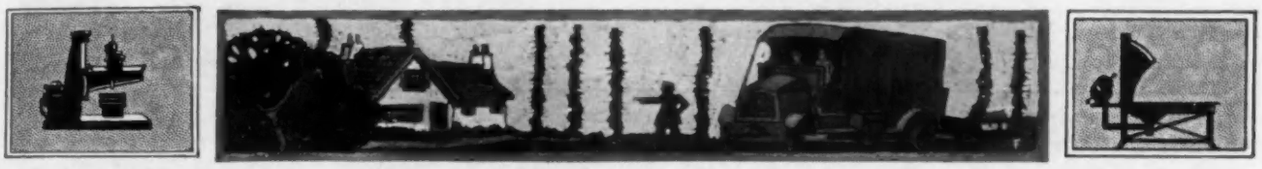
October 10, 1918 **American Machinist** Vol. 49, No. 15



Mr. Machine Shop Man, is your imagination a good one? Imagine that your shop was a Belgian

The Manufacture of Diamond Transmission Chain

By J. V. HUNTER
Western Editor *American Machinist*

One of the noteworthy developments in the line of power transmission, which in recent years has made remarkable advancement in manufacturing methods, is the transmission chain. The great demand for this chain today has made possible the design and invention of a great number of automatic and semi-automatic machines, some of which are described in this article.

WHEN a firm starts to manufacture an article with the intention of producing the best it is sure to incorporate a large number of its ideals into the development of the proper equipment and methods to attain this purpose. This has been the aim of L. M. Wainwright, president of the Diamond Chain and Manufacturing Co., Indianapolis, Ind., and with which he has been identified for the past 26 years. The improvements in equipment and plant have been continuous as the sizes of chains and the demands for capacity have increased, and this year Mr. Wainwright has seen his ideal realized in the completion of thoroughly modern new factory buildings and the installation in them of the entire machine equipment for the manufacture of Diamond chain. The illustration above shows the main building of the new factory that has recently been constructed by this company.

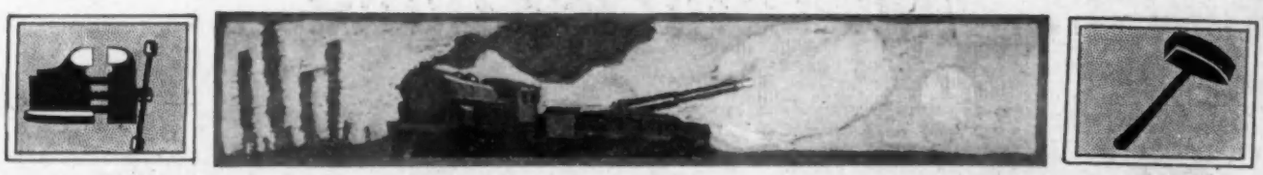
MAIN BUILDING OF THE DIAMOND CHAIN AND MANUFACTURING COMPANY

The buildings are of reinforced-concrete fireproof construction with the most modern heating and lighting arrangements throughout. Special attention has been given to matters that come under the head of welfare work, to which a large part of the third floor has been devoted—such features as a first-aid room, emergency hospital, doctor's and matron's offices and a library. A large dining hall and restaurant on the cafeteria plan has also been provided and is now in successful operation. The toilets are located in towers at the front and rear of the building so as not to take up floor space in the manufacturing rooms.

The main building is 60 x 460 ft., four stories high, and in the rear, connected by convenient inclosed passageways, is a one-story building 80 x 300 ft. In the latter building are conducted all the heat-treating operations on the different parts of Diamond chain and the storerooms for the supplies of raw stock and material.

At the time the shop was visited these departments were not entirely complete in their equipment, but sufficient machinery had been installed to keep up fairly well with the production of the shop. The cyanide-treating room was still located in the old shop, but on account of the poor lighting no views could be obtained of this interesting process. Attention has been given to the installation of assembling and inspection tables so that all operations shall be in proper sequence and prevent any return flow of material in process. The illustration of the building shows the large amount of space that has been allotted to windows. This gives fine, clear daylight across the width of the building, which was purposely designed to be only 60 ft. wide for this very reason. This lighting arrangement naturally aids in the production of more perfect work by the operators and the inspectors.

The use of Diamond roller chain for drive between the various motors and line shafts is one of the note-



shop in the summer of 1914. Imagine this just as hard as you can so that you and your men and

worthy developments that the visitor first notices. This method of drive will be seen in the illustration of Fig. 1, which shows two motors suspended from the ceiling with chain drive across the short centers to the line shaft. The chain has stood up in a remarkably successful man-

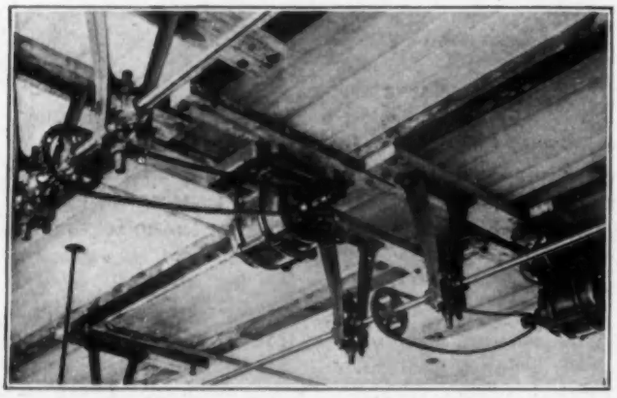


FIG. 1. CHAIN DRIVE FROM MOTOR TO LINE SHAFT

ner for this purpose, and similar drives have been in use for years in their old plant. Later these drives will be inclosed in a light oil-tight sheet-metal case so that they may be run in oil, which will improve their wearing qualities.

Part of the material used in the manufacture of roller chains comes in the form of rolled strips, but large quantities of round rod are used for pins and rollers and figure-eight-shaped cold-rolled and drawn steel bars are used for block types of bicycle chains. Some idea of the quantity of stock used for this work may be gained from the material shown on hand in the stockroom, Fig. 2. Neatness in the arrangement of stock both in a finished and unfinished condition is one of the characteristics of this plant. Two of the stockrooms for the storage of finished chain and parts are shown in Figs. 3 and 4. Steel shelving and bins are used entirely throughout the plant and no permanent wood shelving of any kind is permitted. One feature is a narrow platform half way between the floor and ceiling so that the stock keeper may more readily get at the upper bins, as illustrated in Figs. 3 and 4.

Steel Used

In the manufacture of chain different grades of steel are used, the grade depending on the part of the chain to be made and also the service the chain must render. The side links are usually of carbon steel from 0.40 to 0.50 per cent. carbon. For heavy-duty and unusual service chrome-nickel steel is used for the side links. A low-carbon, dead-soft annealed strip steel is used for forming rollers for the smaller sizes of chain by an interesting process which will be described later. The wearing qualities of this steel are obtained by a thorough heat-treating process. The cold-drawn bar stock ranges from 0.30 to 0.40 per cent. carbon and is also subjected to a pack-hardening process which gives the steel a long-wearing surface coat.

The engineers of this company have made an exhaustive study of the steel question and heat-treating methods because much of the chain may be subject to considerable abuse when in service and only the hardest and toughest material will endure.

Press Work on Side Links

The production of the side links is entirely a punching-machine job. These are flat punchings for all styles of roller and block chain similar in general shape to that indicated at *A* and *B*, Fig. 5, where *A* illustrates the larger sizes used for truck drive and power transmission and *B* the small sizes for bicycle chain, etc. One noticeable feature of Diamond chain n the larger sizes is the bevel edge that is pressed on it as indicated at *A*; this is a separate and interesting operation. In assembling, this beveled edge is turned inward on the inside links where it comes in contact with the sprocket teeth (to avoid a tendency to cut and wear) and outward on the outside links, adding to the finished appearance of the chain.

The stock for side links is obtained in long coils of flat strip steel. In Fig. 6 is illustrated a Bliss punching machine which has been fitted with an automatic-

FIG. 2. RAW MATERIAL IN STOCKROOM

feeding attachment for advancing the stock the requisite distance between the dies after each stroke of the punch. In this figure the strip of stock may be seen at *A* as it enters between the friction rollers *B* which feed it forward to the dies. The pressure on these rollers is regulated by means of suitable screws on top of the housing. The drive for these rollers is by the ratchet wheel *C* and ratchet lever *D* which is rocked forward and back by the connecting arm *E* operating in turn from the ad-

your shop will really be Belgian for the next five minutes. Every few hours in those days a

justable slotted disk *F* on the main crankshaft of the punching machine.

A more detailed view of the punch and dies and part of the feeding mechanism is given in Fig. 7, which has been lettered to correspond with Fig. 6.

In this it will be noticed that the die *G* cuts two links at each stroke from the width of one strip. The punched stock is seen passing on to the right of the die. The spring-adjusted rollers *H* hold the strip in correct position.

Punching Side Links

In the smaller sizes of the side links the holes are punched for the center of each link end before the links are blanked from the strip. In larger sizes the links are blanked first, then beveled, and lastly the holes are punched and shaved.

All holes are shaved, as the necessary clearance allowance on the dies results in a slightly tapered hole. The hole is therefore purposely made from 0.012 to 0.015 in. under size, and the shaving leaves the hole about 0.003

FIG. 3. STORAGE SHELVES AND STAIRWAY TO BALCONIES

in. under the diameter of the pin that will be driven into it later.

The larger sizes of links are punched in a similar manner on heavier types of punching machines, and the same feed arrangements are used, but only one punching is made in the width of a strip. The holes are generally not punched until after the link is blanked; then they are taken to an automatic punching machine such as shown in Fig. 8.

The blanks are stacked by hand in the magazine indicated at *A*, from which they are fed by the feed-control arrangement *B* against suitable stops in the dies *C*. The feed control-lever *D* is operated by a connecting-rod from an eccentric on the punching-machine crankshaft.

After the first punching of these heavy links and

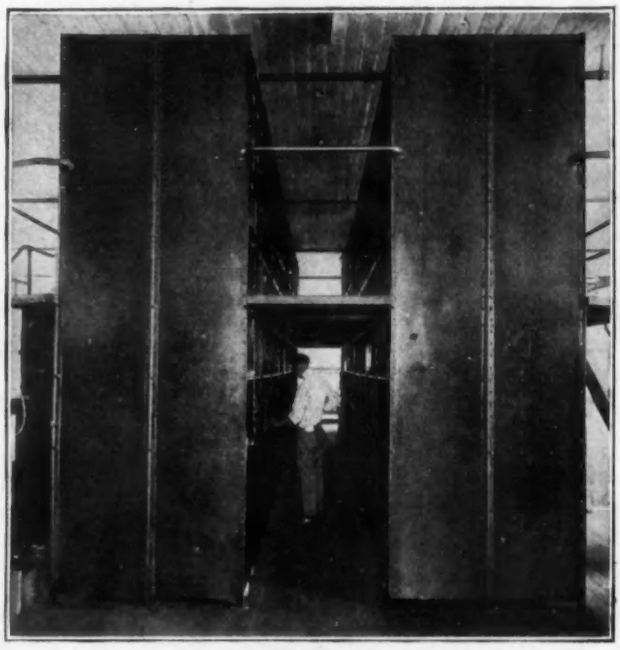


FIG. 4. STEEL BINS FOR STORAGE OF PARTS

before the final trimming of the hole they are transported to the heavy machines, one of which is shown in Fig. 9, for the pressing of the beveled edge. The dies are so constructed as to fit the outline of each size of blank and the upper die has a bevel-edged recess to produce the desired results. Naturally a considerable degree of pressure is required to obtain this result, and the metal will be found to have forced out slightly

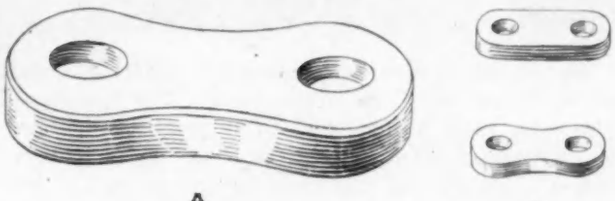
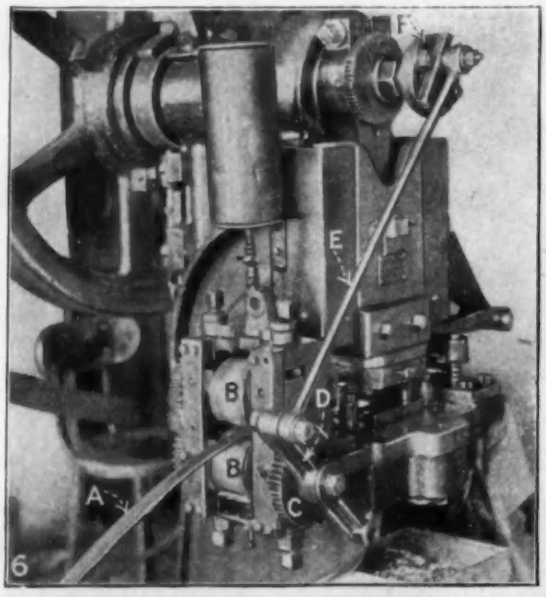


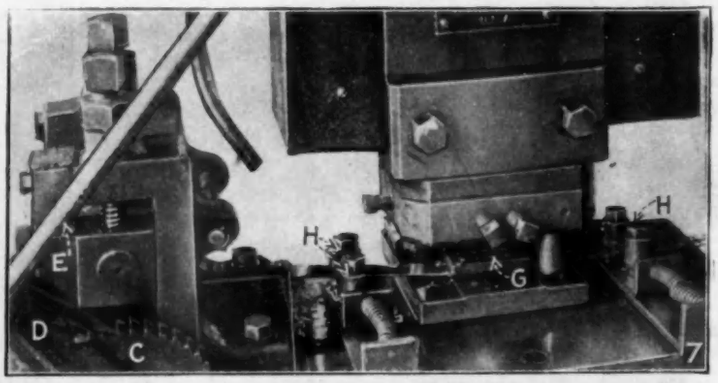
FIG. 5. TYPES OF SIDE LINKS

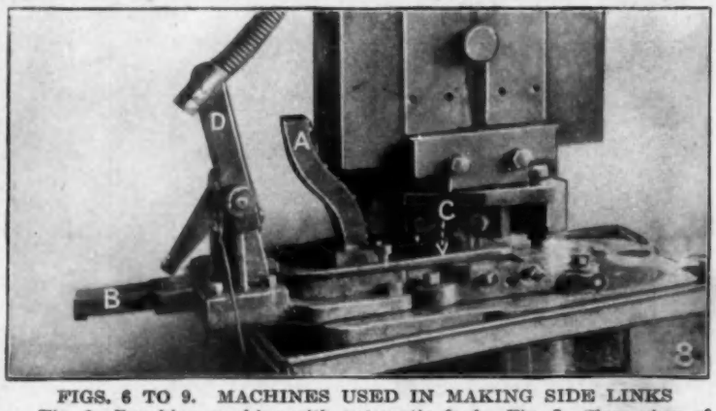
around the sheared edge of the link, and at this point therefore will be harder and more dense. These machines are automatically fed. The arrangement as shown in the illustration is operated by the cam *A*, which pulls back the lever *B* until this is tripped at the proper instant, ejecting the pressed link and pulling a

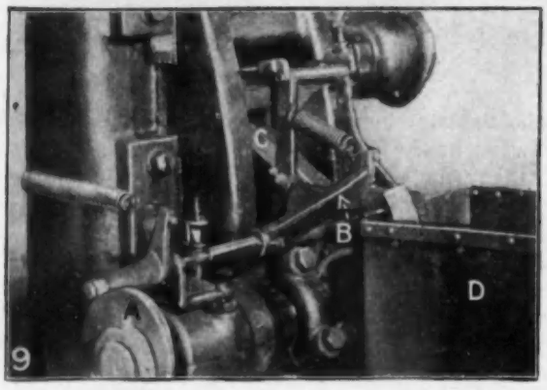
mounted messenger would come galloping past the shop door and shout to you that the Germans

fresh piece forward in its place. An ingenious arrangement in the dies, which cannot be shown by a photograph, is two pins which assist in ejecting the links from the upper die. After pressing, the pieces slide down the chute *C* into the bins *D* which are used for transporting these parts throughout the shop.









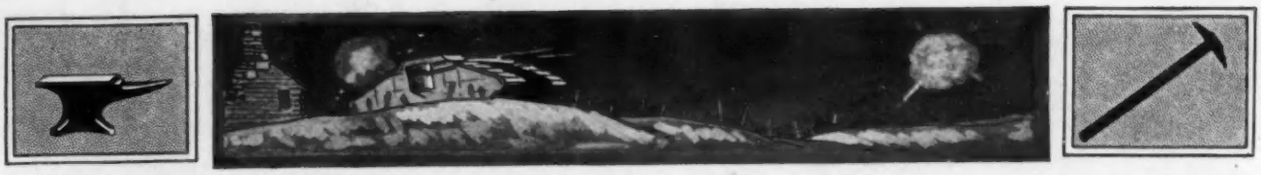
FIGS. 6 TO 9. MACHINES USED IN MAKING SIDE LINKS
Fig. 6—Punching machine with automatic feed. Fig. 7—Close view of dies and automatic feed. Fig. 8—Automatic feeding device. Fig. 9—Punching machine and automatic feed for beveling edges of links

These portable bins are illustrated in Fig. 10, which shows the peculiar form of legs upon which they stand, permitting an elevating truck to be run beneath them.

The work on the links has now been carried forward to a point where they are ready for trimming the holes to bring them within the sized limits which have been specified in a previous paragraph. The larger sizes of links are strung on long U-shaped pieces of wire over the two open ends, one of which enters through each hole of the link, and then inverted so that they stand in the magazine as shown at *A*, Fig. 11. As these pieces feed down to the magazine they are caught by the reciprocating slide *B*, which feeds them beneath the subpress *C* and places them in the correct position so that the coming stroke of the punches will accurately trim the holes. A subpress is used to assure accuracy of alignment, permitting punches and dies to be used with a minimum amount of clearance in order that the holes shall have practically no taper.

When the punch rises on its upward stroke the trimmed blank is automatically ejected from the rear of the press, as shown in Fig. 12. A continuous flow of cutting oil through the pipe *A* is used on these dies in order to permit them to maintain their efficiency. Below the die is the collecting pan *B*, with the drain pipe *C* allowing the oil to return to the supply pump. The chute *D*, which conveys the trimmed blanks away from the die, has its upper end perforated with small holes where it passes over the oil-collecting pan so that all excess oil remaining on the punched blanks will have a chance to drain through and return to the pump.

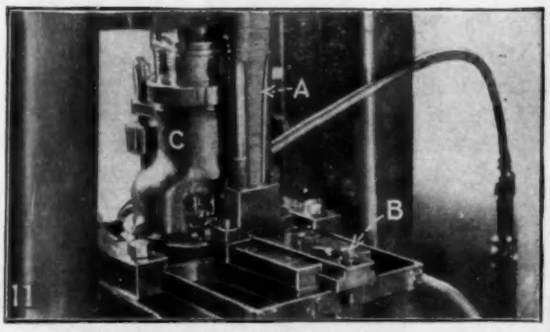
For trimming the many millions of side links which are used in the manufacture of a lighter type of chain an automatic device shown in Fig. 13 is used for filling the links in the long tubes shown at *A*, which act as magazines in feeding these pieces to the trimming machines. The links are poured into the funnel-shaped

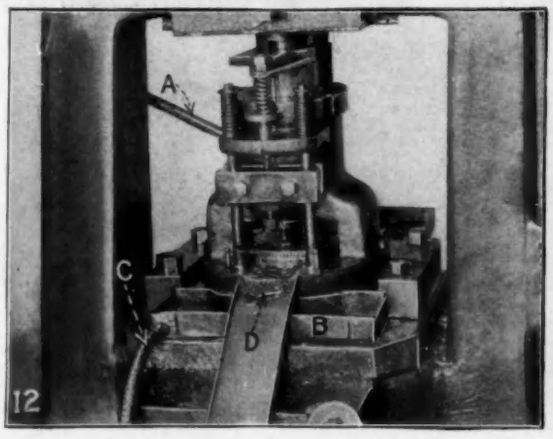


were getting closer and closer and you passed this word around the shop to the men. It made them

magazine shown at *B*, which by means of the belt drive is rapidly jolted up and down. In the center of this funnel is a tube, which is forced up and down through the blanks contained in it. This tube has an open end of the size of the end of a blank, and the jolting action forces these blanks to enter it one at a time, and they then slide lengthwise down it into a special mechanism located at *C*. There a little ram pusher forces the blanks forward and into line with the magazine tube *A* into which another little pusher crowds them until the tube has been filled throughout its length.

An operator who attends several of these machines then removes the filled magazine and replaces it with an empty one. This same magazine-filling device is used in other parts of the plant for filling magazines used to feed drilling and other machines.





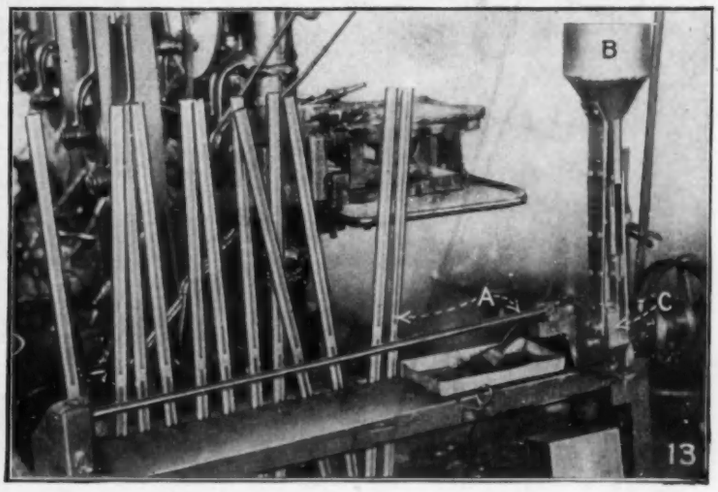


FIG. 10 TO 13. DEVICES USED IN MAKING SIDE LINKS

Fig. 10 Truck and portable bins. Fig. 11—Subpress for retrimming holes. Fig. 12—Rear of subpress showing further details. Fig. 13—Device for filling magazine tubes

Lathes for the Present Gun Program

BY WINTHROP GATES

Mr. De Leeuw's article on page 491 interests me and I would say that for a lathe to be built and used in the United States his suggestion is practicable, as the concrete can be sufficiently reinforced lengthwise to take care of the boring thrusts. But for a lathe to go "over there" I believe the entire machine, including the bed, should be completely fabricated "over here," if for no other reason than to reduce the erecting time, which in the case of ways to be aligned and grouted *in situ* must be considerable.

If the concrete can be had in monolith form so much the better; but I think it a simple matter to align and grout four or five lengths of lathe bed as compared with the aligning and grouting of a larger number of relatively light and short pieces or ways, especially if the lathe-bed sections are first end-faced, bolted and doweled together (with heavy taper dowels) and then planed in one continuous length on a planing machine sufficiently long to take the entire length, as is the practice of a Chicago firm. It is then only necessary to number the joints before disassembling to have the machine go together again in record time.

work with might and main to turn out as many cartridges as they could so that their brothers in

Electric-Railway Motor Pinion Making

SPECIAL CORRESPONDENCE

Few people who ride in the street cars realize the enormous amount of labor expended in the upkeep of the rolling stock and equipment. This article deals with but a single phase of this subject, illustrating and describing the making of pinions and gears through which the driving power of the motor is applied.

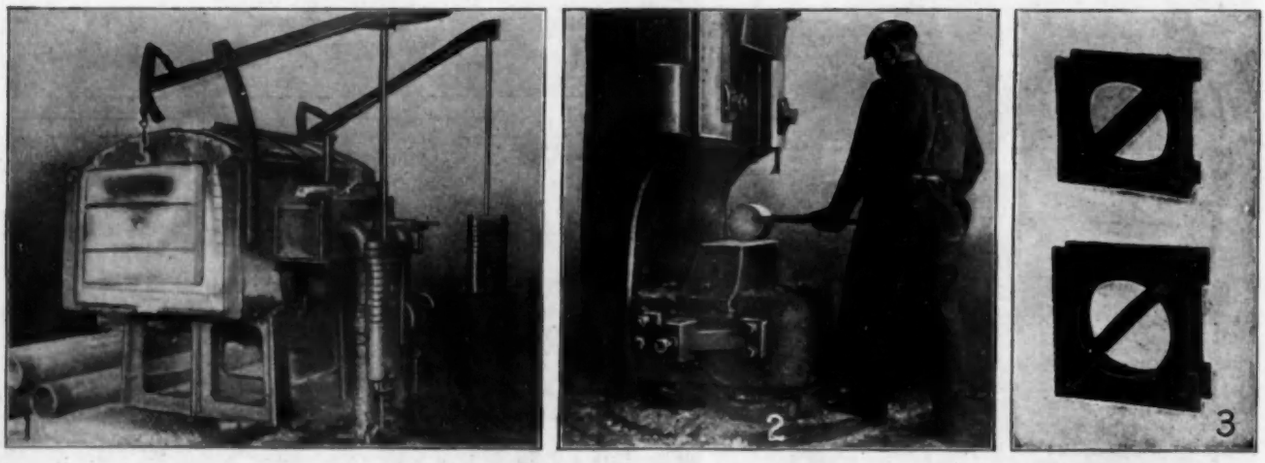
ELECTRIC motors used in driving street-railway cars are arranged to transmit their power to the axle through the medium of a gear and pinion of the proper ratio to maintain the most economical motor speed when the car is running at the predetermined rate, and by suitable gearing the normal full speeed of the motor can be increased within the limits of motor design. A high-speed motor will deliver greater power for equal weight of material and will consequently cost less than one of equal power but of lower speed.

A motor built directly on the axle, while it would avoid the necessity for gearing, would be so bulky, weighty and costly as to be impractical. At the opposite extreme there are certain limiting features in the matter of gear design beyond which it is impractical to go.

The average size of the pinions used on ordinary types of street-railway motors range from 5 in. to 7 in. in outside diameter with a face of from 4 in. to 6½ in., and weigh somewhere in the vicinity of 30 to 45 lb. each.

With street-railway systems operating large numbers of cars, all running into high daily mileage, the wear on the pinion is quite noticeable and a certain number of these are regularly required for replacement. The Twin City Lines operate complete car-building and repair shops and make their own pinions. The material for making these pinions is purchased by the company in the form of rolled-steel billets, approximately 6 in. square and about 4 ft. long. The specifications require an open-hearth steel with chemical properties as follows: Carbon, 0.40 to 0.55 per cent.; manganese, 0.40 to 0.75 per cent.; phosphorus, below 0.04 per cent.; sulphur, below 0.04 per cent.; and it is also specified that the billets shall be free from flaws, blisters, seams, etc.

These billets are first heated in the furnace shown in Fig. 1, which will hold several at one time. It is equipped with two large burners and will heat the billets very rapidly. The burners were operating on fuel oil at the time the picture was taken, and although they were turned low a remarkable absence of smoke will be noticed.



FIGS. 1 TO 3. FORGING A PINION BLANK
Fig. 1—The billet furnace. Fig. 2—Forging a blank. Fig. 3—Gages for pinions

When a billet is thoroughly heated it is carried to a steam hammer, where it is cut into sections of a size each sufficient to forge one pinion. When the cutting is completed (and it requires but three or four blows of the hammer for each cut) the pinion blanks are thrown into the furnace for reheating to the proper temperature.

The next operation is to forge them into round blanks, and such a forging nearly completed is shown under the hammer in Fig. 2. It requires much skill

the Belgian army could kill as many as possible of the dastardly invaders who were even then at

to handle these blanks and forge them to close shape and dimensions; but with a skilled man on the job it appears to be a very simple performance. A heavy hammer is necessary for this task, as a light one will not work through the steel; light blows draw the steel more on the surface than in the center of the blank, making a hollow or concave end. This is mentioned because experience has indicated the need of care in forging operations, there being no doubt that conscientious hammer work helps to refine the steel and gives a denser structure.

The carbon content of this steel is so high that the forgings cannot be permitted to cool in the open air, but as they come from the hammer still at a bright-red heat they are bedded in air-slacked lime and are kept covered for at least two days, allowing them to cool very slowly. Air-slacked lime is excellent for this purpose; pinions bedded in this material for as long as 14 hours have been found to be still at a dull-red glow, and even after 48 hours they were still too hot for handling.

Gages for different sizes of pinion blanks are shown in Fig. 3, a number of them being in service. Each of the gages consists of two parts, "pass" and "not pass." They are cut from No. 10 gage steel and the parts are held about 2 in. apart by bolts with pipe spacers. The strap across the top is for handling. It will be noticed that the right edge of each gage is notched to provide a gage for the height of the pinion forging.

The first operation in machining a pinion is to rough-bore a 2-in. hole through the center. An axle-boring lathe is used for this purpose when available because of the great speed at which it can bore such a hole in this grade of material. This machine has a hollow cutter bar carrying a high-speed cutting tool on the

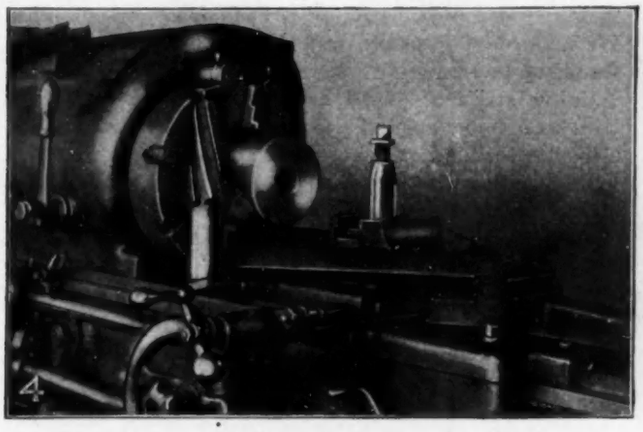


FIG. 4. REAMING THE TAPERED HOLE

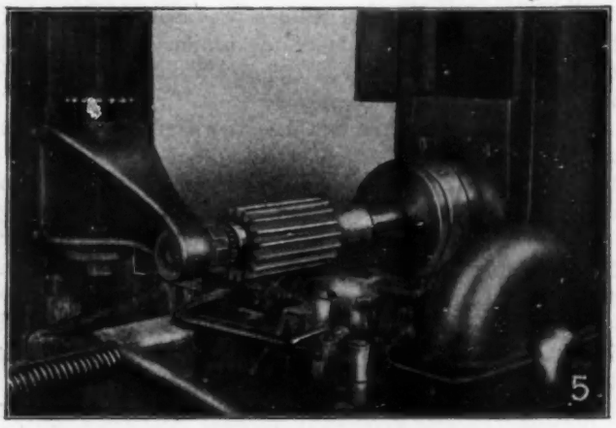


FIG. 5. CUTTING TEETH ON THE PINIONS

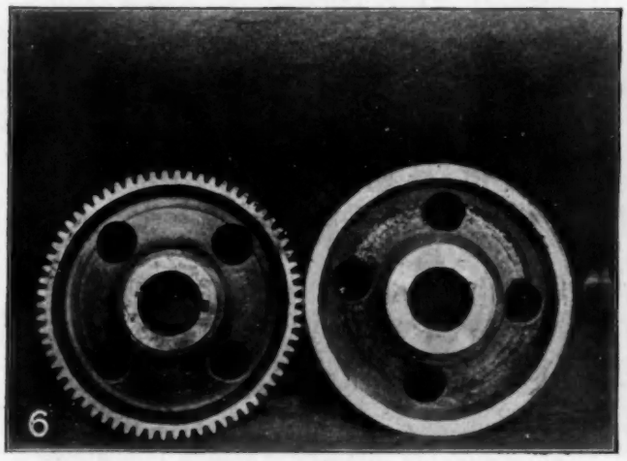


FIG. 6. AXLE GEAR AND BLANK

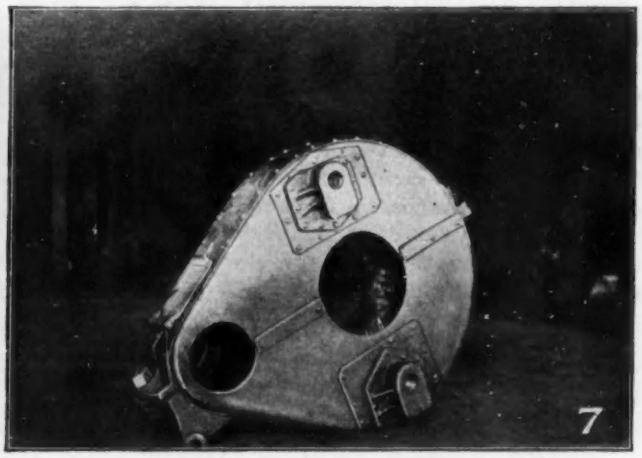
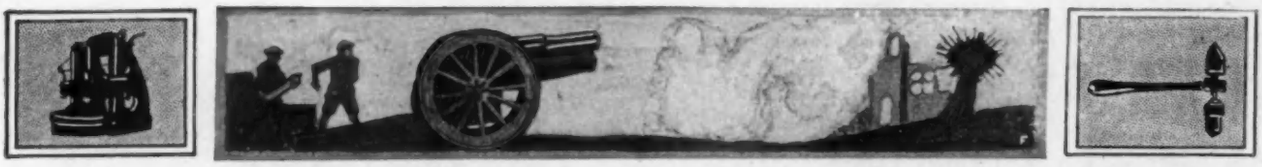


FIG. 7. CASE OF SHEET METAL



the gates of your city; the horrible barbarians who had spit upon their solemn treaties and were

end, and by flood lubrication of this tool it can be driven through the work at very high speed.

The pinion blanks are then chucked in a Pratt & Whitney lathe, as shown in Fig. 4, and taper bored and reamed to fit the end of a standard motor shaft.

Taper sleeves and spindles are provided for finishing the outside face and ends of the pinion in a standard engine lathe. A keyway is cut and a small slot milled in the end for a lock washer.

The teeth are cut on a Gould & Eberhardt gear-cutting machine, using high-speed stocking and finishing cutters; this cutting operation handles two or three pinions at the same time, as illustrated in Fig. 5.

The pinions are now returned to the forge shop for heat treating. In heating care must be taken to turn the pinion frequently to insure uniform heating. The oil used is a standard mineral-quenching oil contained in a double tank in which the inner tank containing the oil is surrounded by a circulating bath of water.

The axle gears used in connection with these motor pinions are purchased as blanks, and the teeth are cut on the machine used for cutting the pinion. In Fig. 6 is shown a blank and a cut gear. The long life of these gears and pinions is due to some extent to the excellent system of protection and lubrication which prevents the accumulation of dirt in the gears and provides a constant supply of grease.

Malleable gear cases are furnished with the majority of railway motors, but these are heavy in proportion to the service they render, and when damaged can be straightened and patched to but limited extent. Consequently this company has undertaken to construct their own gear cases of sheet metal. A good view of this gear case is shown in Fig. 7.

In making these cases the sides are flanged on bull-dozer dies into the general form and the axle and shaft holes punched. The fittings provided on the sides for supports and on the ends for closing are malleable castings especially designed for this purpose.

Increasing Efficiency of Foreign Employees

By A. P. Gwiazdowski
Associate Professor of Mechanical Engineering, Toledo University

The great demand for skilled mechanics forced the manufacturers to organize educational departments, vestibule schools, welfare work, etc. All these activities barely scratch the great masses of foreign labor, both skilled and unskilled. And yet we are going to depend to a great extent on the officially alien enemies in the near future. How can we transform an unskilled man into a mechanic, a one-operation man into an all-round machinist, in the shortest possible time? How can we increase the efficiency of those who are already mechanics? These are the problems of the moment, and the experience of the municipal university of Toledo may be of interest to manufacturers as well as to trade schools.

Shop courses were started in 1914 with five machine tools and an appropriation of $39 for one year's supplies. We trained 16 students in 1914 and over 200 in 1917. Our shop is running 11 hours a day, and we have been training students of 10 different nationalities. Our boys are doing splendid work in the local industries, although this is not generally known. Scores of them, though anxious, cannot fight, being officially alien enemies, but they are doing their part by working in the war industries efficiently and honestly.

The key to our success is as follows:

1. The head of the shop and his assistants are naturalized foreigners, who went through the mill of hardships themselves, and therefore understand and have sympathy for their students.

2. Sunday afternoon lectures in the language of the students bring out discussions on such subjects as history, political economy and the principles of civics.

3. Since 75 per cent. of our foreign students understand the Polish language, we published a book in Polish with the English terminology. The book contains shop mathematics, gearing and important machine tools. This book has greatly helped our students and many young men outside of Toledo, and we are preparing another volume on machine drawing and modern shop practice. These books have paved and will pave the way for many of the boys to our trade schools.

4. It is the business of our instructors to show the students the benefits derived from reading the *American Machinist*. We also equip most of them with the "American Machinist Handbook."

5. We require from the instructors absolute honesty in checking and returning the corrected drawings and home work.

6. The logical schedule of subjects is two evenings of shop practice, one evening of machine drawing, one hour of shop mathematics and one hour of shop theory.

7. We do not use exercises in our shop, but duplicate actual shop conditions by building engine lathes, drilling machines arbor presses and all classes of tools.

8. Establishment of a close-touch and ready-to-help system for the benefit of those who have left the school.

I would suggest to manufacturers that they carry the explanations of shop mysteries to their employees in their own language, by publishing books similar to ours in Polish, Lithuanian, Hungarian, etc. As most of these people will stay here for good the English terminology ought to be included. There are only one or two foreign nations which have dictionaries of technical terms, and this is a great handicap and a discouragement to many people.

ravaging and pillaging, burning, destroying and ruthlessly violating your innocent country. Later

The Forerunner of the TANK

By H. H. Manchester

Although the tanks and their successes in the present war came as a great surprise, the idea which they embody goes back many centuries; in fact almost to the beginning of human records. It is even possible to state that not only victory in various wars, but the supremacy of certain peoples were due to the tank's crude but effective predecessors.

PROBABLY the earliest known forerunner of the tank was the ancient war chariot, which, like the tank, was a vehicle to assist in attacking the enemy. The date at which the war chariot first came in is so nearly prehistoric as to be clouded with mystery. The horse, ass and bull, which at different times were used to draw it, were known as early as the paintings in the rock caverns of northern Spain, which date from 20,000 to 50,000 years ago. They appear in these paintings along with representations of the mammoth European bison and other animals now long extinct, but how soon they were domesticated we do not know.

Probably the earliest picture of a chariot is on an archaic Babylonian cylinder seal which is assigned to about 3500 B.C. It has four wheels, and represents a god being drawn by a dragon. It is not certain, however, whether such a chariot was used in war.

What is probably a war chariot is shown in the "Victory Stele" of Eannatum, of Lagash, 2920 B.C., but the part showing Eannatum at the head of his troops has been broken and little remains of his chariot.

An undoubted war chariot, however, is depicted on an ancient Assyrian cylinder seal which dates from about 2000 B.C., and represents the charioteer attacking bowmen on foot, Fig. 1. This chariot has only two wheels and is drawn by a nondescript animal believed to represent a bull rather than a horse. It is probable that bulls and asses were used on chariots before horses, and that horses came in a little before this period.

It is a striking fact that the earliest Egyptian pictures show neither chariots nor horses. Both of these seem to have been brought in by the Hyksos kings who swept over Egypt about 2000 B.C., and inasmuch as the Egyptian civilization was in other respects higher than that of the Hyksos, as well as from other evidence, it is believed that the conquest was due primarily to these new instruments of warfare.

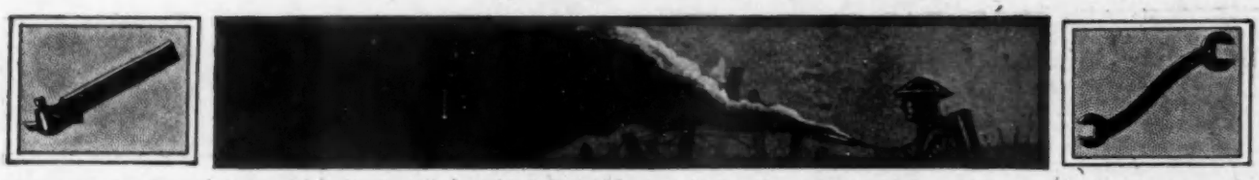
The chariot was one great source of the military strength of Assyria and the other nations of western Asia. Incidentally it was the needs of the charioteer which led to the development of the first great military roads.

How effective these war chariots were is proved also by several passages in the Bible. In Judges, Chapter

FIG. 1. WAR CHARIOT 4000 YEARS OLD DRAWN BY A BULL

I, we read: "And the Lord was with Judah; and he drove out the inhabitants of the mountain; but could not drive out the inhabitants of the valley, because they had chariots of iron." And again in Chapter IV: "And the Children of Israel cried unto Jehovah, for he (Jabin, the King of Canaan) had nine hundred chariots of iron; and twenty years he mightily oppressed the Children of Israel."

In addition to the war chariot, the Assyrians de-



when the advancing hordes had swarmed into your city and you had sent the loads of portable

veloped armored cars to protect themselves from the arrows and firebrands of the enemy. These were used principally in sieges as a cover for battering rams and assaulting troops. A bas-relief in the palace of Ashur-nasir-pal, Fig. 2, dating from about 870 B.C., illustrates such an armored car used in an assault on a walled city. In this case the battering ram projects from the base of the car, while the top is surmounted by a turret, which brings the besiegers more nearly level with the walls of the city.

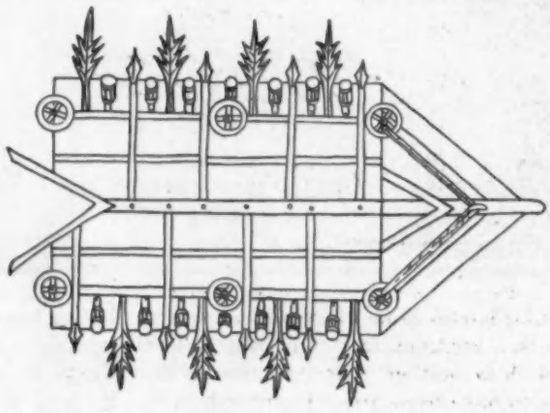


FIG. 4. A TANK WITH CANNON AND LANCES 1400

According to II Chronicles, Chapter 26, Uzziah made engines to shoot stones and arrows, but they may have been used merely for defence and placed upon the walls.

In Homeric days the Greek heroes used chariots, though possibly only to carry them into the fray. Their use in actual warfare was gradually diminished in classic Greek and Roman times.

The Greeks, at least in the later period, made great use of movable engines of war. Dionysius employed them in 399 B.C. at the siege of Syracuse and the next year at the investment of Motya, and he seems to have been the first to have so largely depended upon them. From Sicily the idea was imported to Greece, and we find Phillip of Macedon rolling up such engines before the walls of Byzantium in 340 B.C. and Alexander making use of others at Halicarnassus.

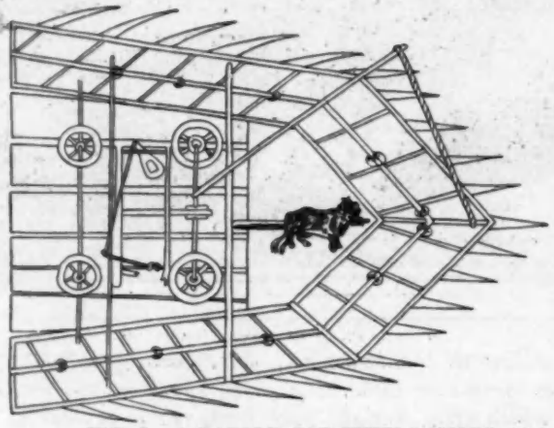


FIG. 5. A BATTLE CAR WITH LANCES, 1400

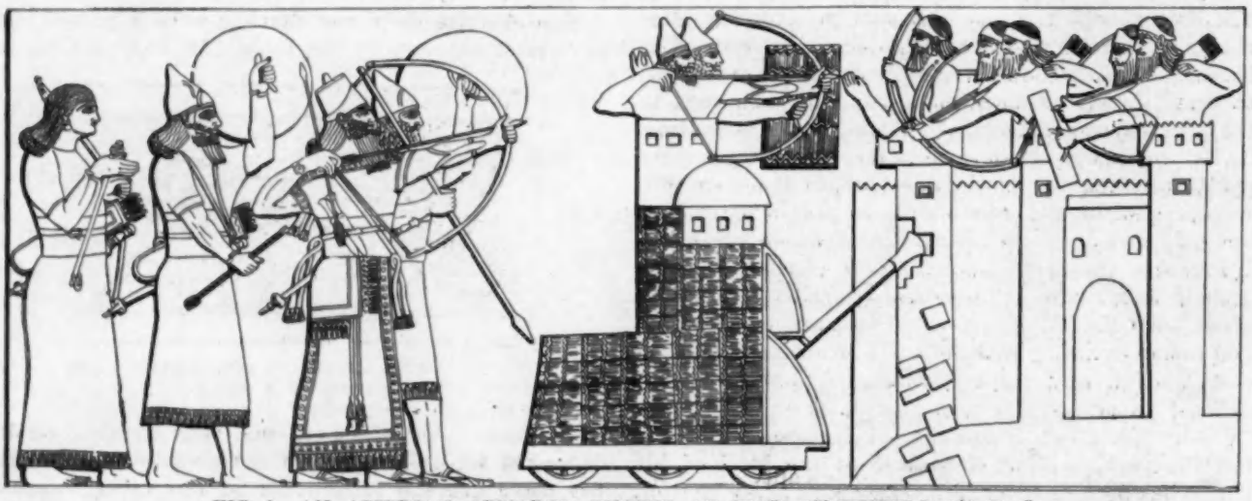
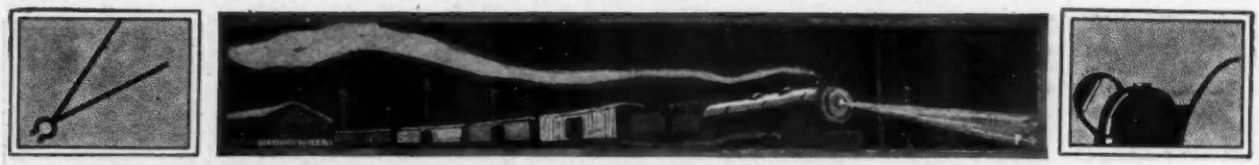


FIG. 2. AN ASSYRIAN ARMORED ENGINE OF WAR ON WHEELS, 870 B. C.

At a somewhat later period the Persians often employed chariots with scythes fastened to the hubs. While these were of some use in a charge, they were about as dangerous to friend as to foe in a crowded meêlée, or in case the horses became unmanageable.

The Romans depended even more upon such so-called artillery. Among their armored vehicles of war were catapults, ballista, onagers, turrets and testudoes. All were mounted on wheels, but were of course slow moving and were used principally in sieges. The catapults



material away from your shop, you and your men seized rifles or pistols and, when these were

shot arrows, the ballista shot stones and the onagers threw rocks or fire. The turrets usually had from six to twelve stories, the lowest of which inclosed a battering ram, while the others held engines of war, bridges and scaling ladders. The testudo, Fig. 3, was

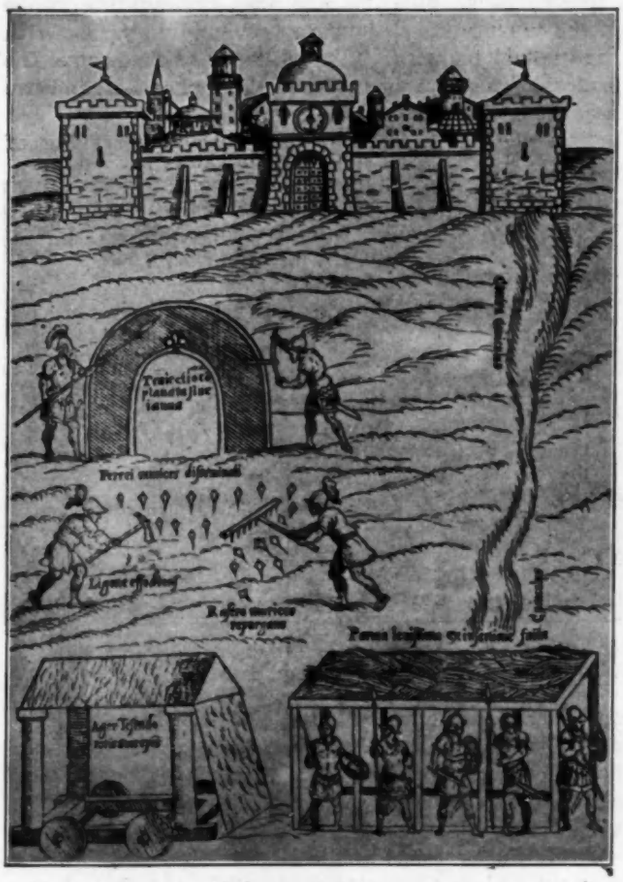


FIG. 3. A ROMAN TESTUDO

a shed on wheels which was used to protect soldiers moving up to undermine a wall. Another device was called a testudo, and although not a vehicle it embodied a similar principle of protection. In this a number of soldiers held their shields so closely together over their heads as to form practically a roof of bronze. They were so closely interlocked that men, and, according to Dio Cassius, even horses and chariots could pass over them. Such a testudo was a highly effective protection, while allowing considerable facility of movement, and was often used in a charge to break the ranks of the enemy.

The Romans seldom used chariots in the midst of a battle, but record that they found chariots with scythes employed by the Britons.

While the use of engines of war was scarcely continued by the barbarians who overthrew the Western Empire, they were long depended upon in the East and later reintroduced in the West.

The introduction of gunpowder seemed at first actually to increase the tendency to use armored war wagons, and we find a number of such early precursors to the tank, though of course without the caterpillar traction. Conrad Kyeser, in his military manuscript, which was written between 1395 and 1405, pictures at least five such "battle cars." Several of them have six wheels, and while some are armed with only lances, others carry both lances and small cannon. They were of various shapes. We reproduce a rectangular one, Fig. 4, armed with cannon and pikes or lances. In this the motive power is not shown, but it may have been pushed along by the men inside or by horses or oxen. In a pentagonal one, Fig. 5, oxen are shown within the car.

The intention was to have these war wagons of considerable size. In 1420 Fontana designed a battle car large enough to inclose men sufficient to rush the wagon along with others shot out of the portholes with the crude firearms of the time. The next year a similar car was designed by Archinger to inclose 100 men.

Probably the earliest attempt at a self-moving vehicle grew out of this idea of a battle car. This was a design for a war wagon to be run by wind wheels, Fig. 6. It appears in a work by Valturio, which dates from 1472. Wind wheels had of course been in use for several centuries, and it was only natural that some one should attempt to apply the idea to a vehicle. The

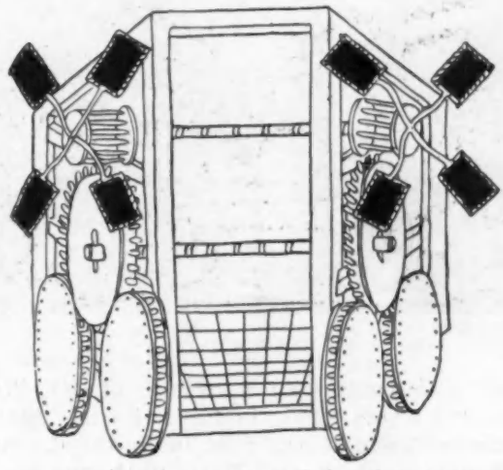


FIG. 6. AN ARMORED CAR TO BE RUN BY WIND WHEELS, 1472

little wind wheels are in amusing contrast with the huge wagon which they were expected to move, and one wonders what would happen if the wind died down when the wagon was in the midst of the enemy. The crude gearing is typical of the period. It will be noticed also that the artist had a mistaken idea of perspective,

lacking, reaping knives and scythes, and hurried to the front to help your brothers of the army.

and has made the two sets of wheels point toward each other rather than run parallel.

Leonardo da Vinci also made a rough sketch of a wagon to be run by internal means, a horizontal wheel probably intended for war, but the sketch does not indicate it.

Similar self-moving wagons were designed at the behest of Maximilian I of the Holy Roman Empire. Some of them were apparently used about 1526 in a pageant commemorating his triumph, but these were for show purposes, and whether he tried out any such wagons in war is doubtful.

A highly interesting war wagon is that pictured by Holzschuher in 1558 (see headpiece). While the design differs little from that of Conrad Kyeser a century and a half before, the drawing is striking in showing the wagon in use in the midst of a battle. The car is pointed at both ends, with numerous port holes from which musketry fire is spitting forth. The picture indicates that lances were still even more common than firearms and that the armed knight on his charger was still a feature of the battle. As in other cases this wagon was supposed to be run by a force of men inside.

FIG. 7. A LAND BATTLESHIP, 1599

Another unique design for a vehicle of war, Fig. 7, was that by Simon Stevin in 1599. He took his idea from the battleship of that date, and practically set up a miniature one on wheels. It was to be run by sails and have small cannon projecting through the portholes in its sides. Stevin's engraving shows this land battleship running blythely along the sands of the seashore. Two such wagons are reported to have been actually constructed by Stevin for the Prince of Orange, but whether they were tried out in war or not is uncertain.

The earliest English patent for a self-moving wagon which could, if desired, be used in war, was probably that taken out by David Ramsey in 1634. In 1658 Caspar Schott designed one to inclose 100 men, and to be employed against the Turks.

One reason why such battle cars were at that time expected to be effective was that the fighting range of the cannon was still only a few hundred yards. With the gradual increase of the efficiency of field guns, the protected war wagons offered less promise, and we hear little more of them for another century.

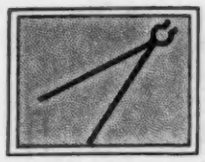
In 1760 a rather artistic but curious engraving of

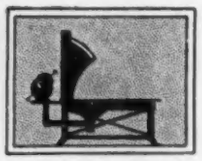
FIG. 8. A CANNON ON A CAR TO BE RUN BY FOOTPOWER, 1760

one, Fig. 8, was put out by Gabriel Bodenehr. Elaborate as this seems, the only motive power was supposed to have been furnished by the soldiers seated at the rear of the car, who treadled cranks connected with the axles.

After the practical application of steam by Watt in 1765 we find an early attempt to apply it to land transportation in what must be considered the first steam automobile. As early as 1769 Cugnot in France set a steam boiler upon the frame of a wagon and succeeded in making the wagon go. His idea was that this invention could be used in war, and on this presumption he was the next year assisted by the government to construct an improvement. The speed, however, was scarcely more than 2½ miles an hour, and the machine would run only 20 minutes before he had to stop for 15 minutes to get up more steam. In his first public trial he had the ill luck to run into and knock down part of a stone wall. This led to his being temporarily cast into jail, and his experiments were abandoned.

Napoleon must have visualized the possibilities of Cugnot's machine for military purposes, for when the great general was elected a member of the French Institute, the subject of his paper was "The Automobile in War."





It wasn't work or fight; it was work and fight too, without thought of anything but that the wild

The Development of Gun Manufacture

By LIEUT. W. H. W. SKERRETT

Abstract of a paper read before the Detroit Section of the S. A. E.

The historical development of various implements of war just at this time is especially interesting. This article reviews the construction and manufacture of guns from the earliest times up to the present high-pressure methods.

BEFORE the beginning of the great war the average civilian had but a vague idea of the part which artillery plays in the modern battle. As we look back upon those terrible days which preceded the battles of the Marne and the Aisne we realize how grateful civilization must be that the English and French had foreseen the rôle which field artillery would play in a modern battle.

The original gun of ancient times bears little resemblance to the pieces used today. The first guns of which we can find record appear to have been made in Ghent in 1314, at which time an entry was made in the town clerk's records of a "gun with powder" being sent to England. According to pictures made about that time, the gun was vase shaped (the Italian name for it was "vase") and was used for shooting darts. Powder was placed in the bowl of the vase and an iron dart was rammed firmly into the neck. The neck was made gas tight by means of a tampon wound around the shaft. A touch hole in the side was used. The range was a few hundred yards.

Most of us believe that guns were first used in 1346 at the battle of Crecy, for it was there that the English used their three guns with great success against foot soldiers and mounted men. This is perhaps the first record of guns in a field battle, and so we may say that field artillery was born at Crecy, although 15 years before (1331) siege guns had been used at Clividale in Italy. The projectiles used were rounded stones smaller in diameter than the bore of the guns. Pressure was obtained by wadding the charge with turf. The guns at Crecy used iron slugs, which were very effective against horses.

Little development occurred in field artillery, however, during the next hundred years, although siege guns of large size appear to have been used. In 1446 the hand gun, or musket, made its appearance and became the deciding factor in battles from that date. With the increasing superiority of musket fire, artillery quickly fell into disuse, and not until 1630 did it again advance to a position of importance.

In 1631 Gustavus Adolphus, King of Sweden, made use of mobile artillery in sweeping over most of northern Europe, especially that part now occupied by the German Empire, and with less than fifty guns drove his opponents into their fortified towns where he besieged and defeated them.

Gustavus was the first to classify and set limits upon heavy and light artillery. He classed as light or mobile artillery all guns up to and including the 12 pounder (a light 3 in.), but recommended an 8 pounder or lighter for extensive campaigning. In fact, in 1632, when he finally defeated Tilly, he was able to cross the Danube in face of a much superior force by reason of the mobility of his 4 pounders, of which he possessed about sixty.

Advent of Breech-Loading Guns

Some early attempts were made to overcome the difficulties of muzzle-loading guns and breech-loading pieces were unsuccessfully tried. These were failures for two main reasons—the necessary strength could not be obtained and the gases leaked through the joints. So hazardous, in fact, were these guns that they were abandoned, and it was not until 1845, when Major Cavalli, a Sardinian officer, introduced the sliding-wedge type of breech block, that muzzle loaders began to lose first place.

In this gun, which was also one of the first to be rifled, the chamber was sealed by a copper plug and an iron wedge was inserted through the body of the gun, which prevented the copper from being blown out.

Until 1739 all guns had been either cast or forged on a mandrel, and naturally the bore was rough and full of irregularities, which allowed the gases to leak around the projectile and reduced the power and range to an enormous extent. The range at best was only a few hundred yards, and the flight of the shell inaccurate. The wadding was very important, as upon it depended the pressure developed, and therefore the velocity of the shell.

Powder also was an unknown quantity, one kind being much more powerful than another. We wonder that results could be obtained when so many variables were introduced.

With the advent of bored guns—Maritz, a Geneva gunmaker, in 1739 having bored the first from a solid-bronze casting—the power and accuracy increased immensely.

In the eighteenth century wheeled mounts were also introduced successfully, and artillery became mobile enough to accompany troops in the field, to maneuver ahead of them and to break up enemy formations before the infantry attack could be delivered.

beast must be held back until the men of France and England came. And because you and your men

During the early part of the eighteenth century the approved strategy consisted of driving the enemy's army back upon some fortified town by a series of cavalry and infantry attacks or battles, and then besieging the town until it surrendered owing to sickness or starvation. If necessary, heavy howitzers were brought up and the fortifications demolished by gunfire until the chances of carrying the place by assault were assured. About 1760 the idea was introduced of using artillery as a terrible defensive weapon by luring the enemy into battle and then annihilating him by massed batteries using grape shot.

Napoleon used artillery to break up both foot and cavalry charges in both frontal and flank attacks and

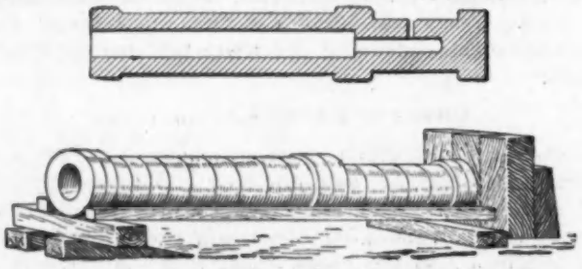


FIG. 1. TYPICAL GUN OF THE FOURTEENTH CENTURY

always maneuvered to bring his artillery out in front of his troops that the guns might open gaps in the enemy line, through which he could later pour his troops.

The position of artillery was changed by the time of the Civil War for the long-range musket or rifle had been introduced shortly before and the guns needed infantry support. Therefore the batteries were placed in the same line as the troops, and the enemy had to

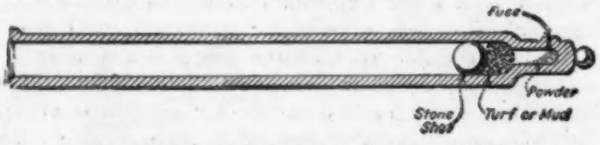


FIG. 2. SECTION OF AN EARLY CANNON

advance into a concentrated rifle and artillery fire in which his own guns could take little or no part due to fear of firing upon his fellow soldiers. The advent of the rifled gun and the explosive projectile made possible the use of batteries behind the lines out of sight of enemy observers, but due to the imperfections of the ammunition the damage done was not in proportion to the increase of range. This brought about a demand for greater range and accuracy.

Lord Armstrong in 1855 introduced the first built-up gun of the rifled type and met with great success. Wire winding was introduced at the same time and was also successful from the start. From 1850 to 1870 the main improvements were in breech mechanisms, rifling and ammunition. The importance of steady flight was recognized, and the long tapered shell took the place of the round shot previously used. This shell was given rotation in various ways, the first plan being that of a twisted ellipse or hexagon. The Whitworth gun had a cross-section which was hexagonal and a twist of one turn in 25 calibers, and the shell was cast with a similar form, making a good mechanical fit in

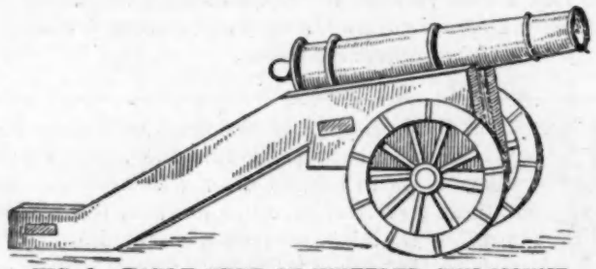


FIG. 3. EARLY TYPE OF WHEELED GUN MOUNT

the bore. This gun and the Lancaster oval bore were troubled by the projectile becoming wedged. Upon this occurring the gun would explode, so that they were abandoned in favor of the grooved rifling which was adapted to studs or lead and copper bands. In 1880 the metallic cartridge case was introduced.

In 1890 nonrecoiling carriages were used. Previous to this the gun and carriage as a whole recoiled after each shot and had to be realigned before firing again. Any attempt to limit recoil had been made by increasing the weight of the mount. The constraining of recoil developed great stresses in the carriage and made heavy cumbersome mounts necessary. With the spring recoil and nonrecoiling carriage the gun was automatically brought into the firing position after each shot.

Accuracy of Shrapnel Fire

After time fuses were perfected shrapnel became one of the most used types of projectile. It is now possible to lay a barrage of shrapnel fire that is accurate to 50 yd., a thing which was impossible until just before the beginning of the present century. The power and velocities of guns were also increased until today we have a gun with a velocity of 4000 ft. per second which shoots more than 70 miles.

We will now consider the component parts of a simple gun and then trace the successive stages of developments through which it has passed in the last few decades, for since 1850 the strides have been enormous.

Fig. 1 shows a simple gun such as was used in the fourteenth century. It consisted of a cast-iron barrel slightly larger than the diameter of the shot which it expelled and a small powder chamber which was filled from the muzzle. The gun was held rigidly between two timbers and prevented from recoiling by stakes driven

had helped your brothers of the army to withstand the unprovoked assaults of these invaders your

into the ground. It was elevated by means of wedges placed beneath the muzzle and had a range of a few hundred yards.

Fig. 2 shows a later development of the same type, which was the kind used for siege purposes during the fifteenth century. These guns often had a bore as great as 20 in. and fired a stone missile weighing 700 lb. a distance of 400 yards. The gun itself weighed 14,000 to 16,000 lb. without its mount and was not mobile. Often these guns were set permanently in emplacements and kept loaded at all times.

In Fig. 3 the elevation of the gun was changed by wedges driven between the intermediate transom and

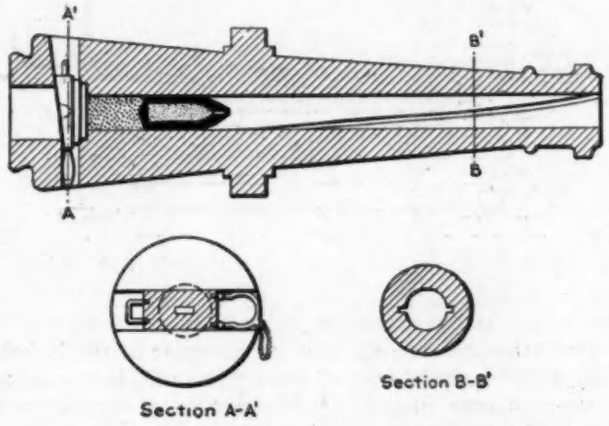


FIG. 4. GUN WITH WEDGE BREECH CLOSED

the breech end of the gun. This type was superseded by a gun which was mounted on a carriage provided with an arc. A lug on the breech end slid in this arc and the angle of elevation was set by placing pins through holes in the arc and lug. This type was used until the end of the Napoleonic wars.

Fig. 4 shows a simple cast gun with sliding breech block. This is the first gun to use the breech-loading principle successfully. The projectile was inserted through the breech and fitted into the rifling. The powder was next placed in the chamber and rammed home. A fuse was inserted in the touch hole and the breech closed by means of the copper plug. The wedge was then driven home, forcing the copper plug tightly against its seat so that it would not allow gas to escape. The force of the explosion merely tended to force the wedge backward and not to slide out of its seat.

Following these operations fire is applied to the fuse sticking from the vent hole, which in turn ignites the powder in the chamber. This is converted into gas, and due to the pressure the shell is driven forward; the rifling grooves hold two lugs which are cast on the exterior of the shell, causing it to rotate. This rotation is necessary, as otherwise the shell would tumble end over end and its range would be decreased.

Fig. 5 shows a built-up gun consisting of a tube *A* or inner cylinder with a jacket *B* shrunk over it. The tube is recessed at the breech end to form the powder chamber *G* and is closed by the breech block *D*, which fits into the bushing *C* as shown. This bushing has an interrupted thread with three blank portions milled out. The breech block with a similar arrangement of threads and blanks is inserted and locked in position by being rotated through 60 deg. The escape of the powder gases is prevented by the gas-check pad *F*, which rests upon the bevel slope *J*. By the action of the gases in the powder chamber the head *E* is forced back, compressing the gas-check pad firmly against its seat. The centering slope *H* enters the shell and the rifling *K* gives it the required rotation. The breech ring *L* is provided with a lug and hole by which the recoil mechanism is attached to the gun. The guide ring *M* carries the guides, which allow the gun to slide in the cradle while recoiling.

The jacket is a forged-steel tube which is bored to a diameter slightly smaller than the exterior of the tube on which it is to be shrunk. Shoulders are counterbored so that the tube will not be driven out of the jacket while firing. Sometimes the jacket is threaded instead

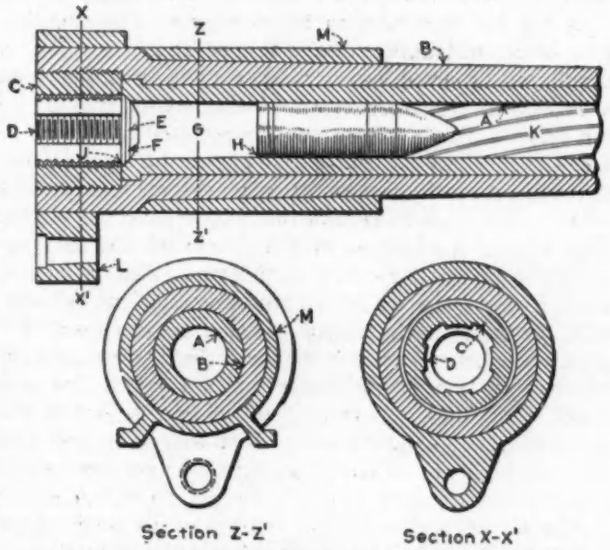
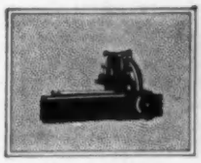
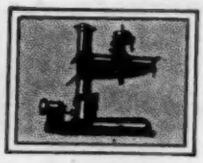


FIG. 5. SECTIONAL VIEWS OF A BUILT-UP GUN

of being provided with shoulders, but this complicates the manufacture and shoulders are more universally used. The jacket is heated in an oil or electric furnace until it has expanded sufficiently to slip over the tube. When it has reached the required temperature it is removed from the furnace and placed over the tube. To insure a contact at the breech shoulder this end of the piece is cooled quickly by spraying with water, which causes it to contract and grip the tube at this point. The rest of the forging is now cooled slowly so that it





city was adjudged by them to have violated the laws of war (as if the beast of the nations knew or

will contract toward the breech end. When finished, the compression is about 50,000 lb. per square inch as a general average.

The breech end of the gun is next threaded so that the breech hoop or ring can be assembled. This hoop, or ring, carries the breech block. In cases where a plug is used the breech hoop is provided with a bearing for the breech-block carrier arm, and when the sliding-wedge type of block is used the breech ring forms the seat for the block and the bearing for the arm and operating lever.

The guide rings are often omitted and the feet are shaped directly from the jacket. These feet slide in a grooved cut in the cradle and guide the gun during recoil.

Recoil-Regulating Devices

There are two main systems of recoil-regulating devices—the spring and the hydraulic. In the spring type the energy of the gun is absorbed by the work done in extending a heavy coiled spring and the piece is returned to the firing position by means of the spring. A counter-recoil buffer is provided so that the gun will not fly back violently after it has reached the limit of its recoil. This is usually some type of dashpot.

In the hydraulic device the energy of the recoiling gun is converted into the work of forcing a liquid, usually oil or glycerine, through a small orifice or past a valve. The counter recoil is effected by springs or compressed air, a buffer being provided as before to ease the shock of return. Fig. 6 shows the cross-section of a typical recoil mechanism. The cylinder *A* contains oil which is forced through the orifice *B* in the piston. This piston is attached to the frame of the carriage while the cylinders recoil with the gun. The cylinder *D* contains air under an initial pressure sufficient to maintain the gun in the firing position at the maximum elevation. Upon recoiling, the air is further compressed, which also creates resistance against which the gun must work during recoil. During counter recoil the compressed air expends some of its energy in bringing the gun back to the firing position and an appreciable amount in forcing the liquid through the orifice in the piston *C*. A counter-recoil buffer is provided at *E*, where the extension of the piston rod *G* enters a dashpot having a minute opening which is regulated by a valve.

Fig. 7 shows a complete gun with gun proper, recoil device, cradle or sleigh, carriage and trail.

The recoil device is carried in the cradle, which can be elevated or depressed. The lateral traverse of the piece is obtained by the carriage, which is hinged directly to the trail. For deviations greater than those possible with the traversing gear on the carriage the trail must be moved.

The trail is provided with a spade which prevents it from recoiling and steadies the whole piece during fire. The strength of a gun is obtained in two ways, first by shrinkage and secondly by wire winding. Wire winding tends to reduce the size of jacket, or covering, necessary to obtain the same initial unit pressure as by shrinkage, for it has been shown by experiment that the pressure resulting from a series of unit pressures in the algebraic sum of the tangential stresses set up by each one individually.

In wire-wound guns two shrinkages should be noted, namely, the absolute and the relative. The absolute

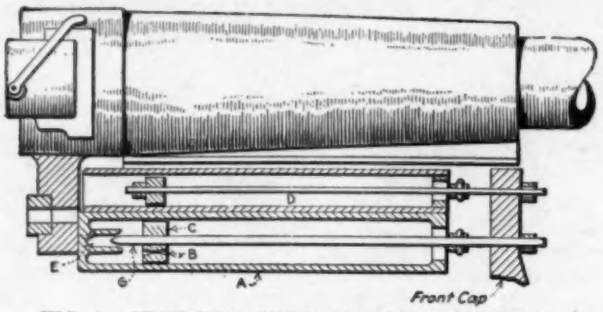


FIG. 6. SECTIONAL VIEW OF TYPICAL RECOIL MECHANISM

shrinkage is the difference between the exterior diameter of the tube and the interior diameter of the jacket. The relative shrinkage, on the other hand, is the absolute shrinkage divided by the radius of the contact surface.

Referring to Fig. 8, where ab is the absolute shrinkage and R_o and R_i the interior radius and the radius of the surface of contact, the relative shrinkage

$$O = \frac{ab}{R_i} = \frac{oc + ci}{R_i}$$

The relative compression is C/R, which is the total compression per unit of radius. It is this value which governs the stress in the tube.

Most compressions and shrinkages are given as so much per inch when worked from the design viewpoint, but for shop use the total shrinkage is given. Thus, taking a tube of 6-in. diameter with 0.001 in. per inch shrinkage, the drawings would show a total shrinkage dimension of 6.006 in., while the jacket would be bored to exactly 6 inches.

Different types of guns may be roughly divided into four classes:

Mortars.—These are pieces with very short barrels, seldom more than 8 calibers in length, which operate against their objective with plunging fire. A mortar is used at elevations between 45 deg. and perpendicular. It should be explained that the term caliber, as applied to ordnance work, means the number of times the diameter of the gun is contained in its length. Thus a 12-in. gun 45 calibers long would be 45 ft. in length.

Howitzers.—These are used for plunging fire and are

cared for law!). A hundred innocent old men, women and children were herded against a wall and

also guns of relatively low velocity, seldom exceeding 1500 ft. per second. They are between 8 and 15 calibers in length and operate between the elevation angles of 15 and 45 degrees.

Field Guns.—These are guns of high velocity, seldom operated at an angle exceeding 15 deg. and depend upon

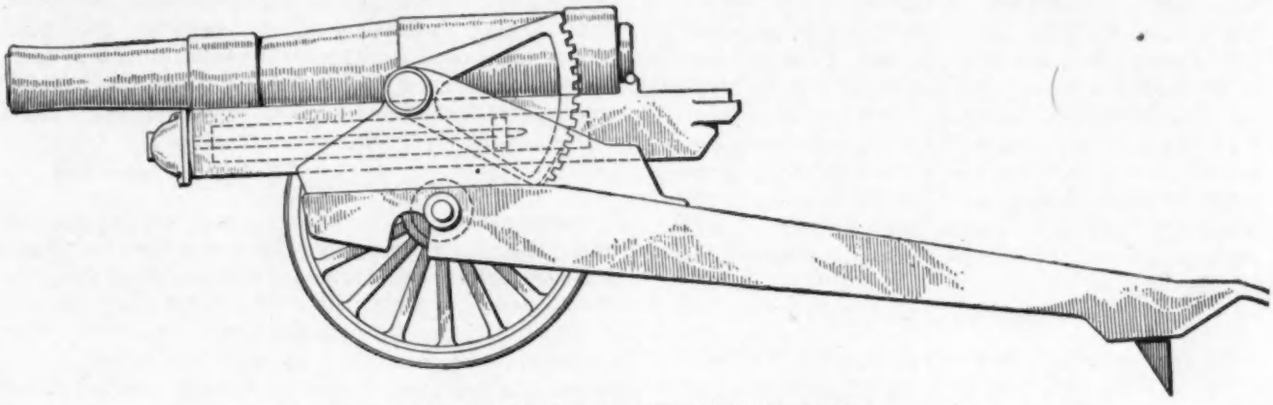


FIG. 7. RECOIL TYPE OF GUN AND MOUNT

velocity for the depth of their effective range. They have muzzle velocities up to 2000 ft. per second and are from 20 to 25 calibers long.

Rifles.—There are naval and siege rifles. These pieces are from 40 to 50 calibers long and employ velocities above 2000 ft. per second. Their range is very great and their accuracy of fire much superior to that of field guns. Although they are longer and therefore harder to mount, some large rifles have been used on railway carriages by the French, and the British have also mounted their excess naval guns in this way.

The requirements of field artillery are threefold—that it be mobile, that its fire be accurate and rapid and that repairs can be easily made. In late years mobile artillery has come to include almost every size and type of gun. Howitzers as large as 16 in. have been constructed which can be removed in a few minutes should the enemy artillery commence to find their range. Some guns as large as 12 in. have been mounted directly on wheel carriages which can be hauled away by tractors. Railway mounts have been developed which will carry almost any gun that can be designed. Almost every type of gun, therefore, except those permanently mounted, may be called mobile. The really mobile artillery, however, includes the light guns—those below 5 in., which are either horse or tractor drawn and can be operated over any kind of ground. The limit of weight in these pieces is usually about 8000 lb. for the gun and limber.

The inspection of modern artillery material is very rigid. We are bound by wise rules in order that the Army and Navy will be supplied with the best material and that it will be uniform.

Our regulations lay down certain requirements for forgings for guns which can be briefly summed up as follows: The chemical analysis is approximately carbon 0.35 to 0.50, manganese 0.50 to 0.80, silicon 0.15 to 0.30 and nickel 2.50 to 3.50 per cent. Sulphur and phosphorus must be less than 0.05 per cent.

The chemical properties are varied to meet the following physical tests:

	Elastic Limit, Lb. per Sq.In.	Tensile Strength Lb. per Sq.In.	Elongation Per Cent.	Contraction of area, Per Cent.
Tubes and jackets..	65,000	95,000	18	30
Small parts and breech blocks	75,000	110,000	14	30

Heat treatment by tempering and annealing is allowed and three official tests only are permitted. If the test pieces submitted do not pass test during one of these

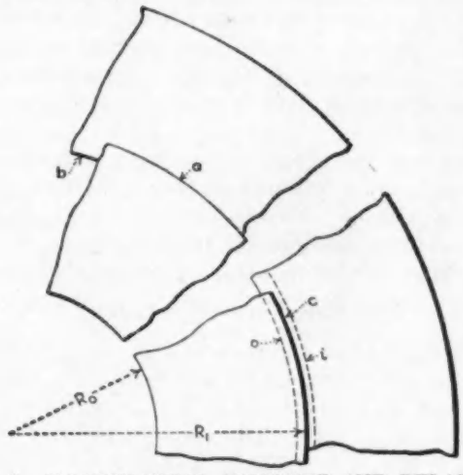


FIG. 8. ILLUSTRATING ABSOLUTE AND RELATIVE SHRINKAGE

three tests the piece or pieces depending upon the test piece are rejected.

The steel used is a good open-hearth or electric steel, free from slag and bottom, cast in either open molds or special ingot-casting machines. The specifications de-

shot. You yourself were forced to stand by and see your father and your sixteen-year-old son put

mand that the cross-sectional area of the ingot as cast be at least four times the area of the block forging which will be made from it. If bored or punched ingots are used for hollow forgings the walls must be reduced 50 per cent. under the hammer. The lower end of the ingot will always be the breech end, as it is usually more free from defects than the top.

A discard from the ingot of at least 30 per cent. by weight from the top and 5 per cent. from the bottom is required in all open cast ingots and is slightly less for fluid-compressed ingots.

Forgings are made on the hydraulic press, steam hammer or on the drop hammer. The use of the press is usually confined to forging shields and other large plates, the hammer is used for blocks, tubes, jackets, rings, etc., while small parts and difficult sections are made by drop-forging.

Heat Treatment

Forgings are annealed above their upper critical point after forging and are then rough-machined. After being rough-machined they are heat-treated so that the steel will be given the necessary physical properties as called for in the specifications. In heat-treating the whole piece never but a part should be subjected to the same treatment, and this also applies to the quenching operation. Likewise, in annealing, the whole piece should be drawn as evenly as possible, and where possible the forging and furnace should be allowed to cool to not more than 200 deg. F. before removing it from the furnace. If this cannot be done the furnace and the piece must be allowed to cool below 600 deg. F. before it is removed and then allowed to cool slowly in air. The last operation in heat-treating a piece must always be a drawing or annealing treatment.

No treatment is allowed after the piece has passed test.

Test pieces are usually taken from both breech and muzzle end of the forging and tangential bars are taken whenever possible. This is because the tangential unit stress is always the limiting feature of gun design, the longitudinal unit stress being much less important.

Standard Test Specimens

The standard test specimen is a bar 4.75 in. long, 0.75 in. in diameter, threaded at both ends for a distance of 1 in. with a ¾—14 threads per inch United States Standard V-thread. The center position between threads is turned to 0.505 in. diameter for a distance of 2.2 in. filleting into the threaded portion with a 0.375 radius. The 0.505-in. diameter gives an area of 0.2 square inches.

Machining of finished material must be carried on with utmost care and all dimensions kept within the allowable tolerance as shown on Government drawings which accompany the specifications covering the particular material. Rough and careless work and finished surfaces showing chatter or tool marks will not be accepted. Where exceptional finish is required file and emery polishing are usually specified. Grinding is allowed, but surfaces are inspected for seams and cracks before grinding, as that operation usually peens out such defects. Cold "shuts," seams, struts, blowholes, sand or slag pockets, pipes or any other structural defects are looked for at each inspection and are cause for rejection. Even "ghost lines" of oxide are carefully investigated, and if numerous or in dangerous positions will cause the scrappage of the forging.

Gun Factors of Safety

The importance of such rigid inspection can be seen from Fig. 9, which gives the tangential resistance, pressure and velocity curves for a hypothetical gun. As can be seen, the elastic limit of the forging is nearly approached by the compression due to the jacket. The pressure curve shows how the gun is strained during firing. At one point the value of the tangential resistance is 50,000 lb. per square inch, while the stress produced by the interior pressure is 35,000 lb. per

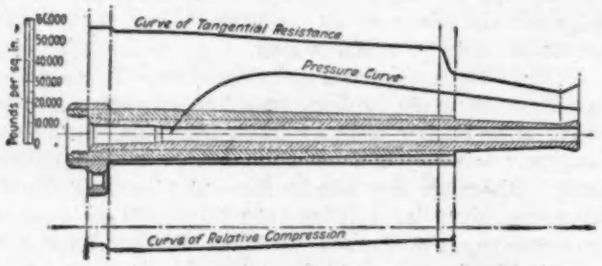
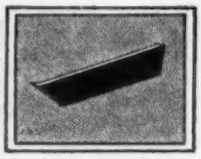


FIG. 9. CURVES OF GUN PRESSURE AND TENSILE STRENGTH

square inch. This gives a factor of safety of 1.43, which is low compared to engineering standards where 5 is a common figure. We will assume that this compressive strength was obtained by 0.006 in. shrinkage. It is easy to figure the effect that a difference of 0.001 in. above or below the 0.006 in. would have. Say the absolute shrinkage had been 0.005 in., then the value of the resistance would be reduced to about 40,000 lb. per square inch and the safety factor to 1.14. If the safety factor is reduced below 1 the tube will explode. On the other hand, assuming that the shrinkage is 0.007 in., the safety factor in the tube will be increased, but the metal of the tube will be stressed above its elastic limit. This in itself is not dangerous, as the walls are well supported, but the danger lies in producing too much strain in the jacket when the internal pressure of the tube is communicated to the outer hoop, with the likelihood of its being split off when the gun is fired.

Is it surprising that when working with such small



to death, and to hear and see the barbarians laugh and joke over their dying struggles. They spared

safety margins we are bound to reject any piece suspected of being weak in the slightest degree?

We must have guns, for we know that guns are the only weapons with which we can kill the most Huns at the least cost to our own army. Every step in ordnance work must be studied and simplified and speeded up.

We will cite an example that has lately come to notice of the way that engineering methods have speeded up our work. The rifling of guns has always been a long and tedious operation. A rifling machine consists of a cutting tool carried on a bar which is made to rotate at the required rate while moving longitudinally through the bore of the gun. The tool thereby cuts a spiral groove in the bore of the gun, the shape of the groove being similar to the cutter used. One, two or four grooves have been cut simultaneously, but when more than one set of grooves are cut, difficulty is experienced in keeping their depths uniform. Lately this method has been superseded in a certain gun shop by a set of broaches which have cut the time of rifling from 6 hours to 45 min. for the particular type of gun made there.

Hundreds of other problems in ordnance work will show similar savings of time if they are given the attention which they deserve.

For success armies are dependent upon their equipment, and they cannot gain victories unless they have a superiority of material.

There is no gain in having the best guns in the world or the best planes or trucks if we have only a few, for the Germans have turned their whole attention to making these articles and are turning out vast quantities of them daily. Unless we have more of them than the Hun we will not be able to defeat him quickly and we will have to pay dearly in lives and money.

The Modern Foreman—What Is His Present Job?

By E. Andrews
Manchester, England

The article by Entropy on page 799, Vol. 48, is of more than passing interest because it shows clearly that the changed conditions of modern industry necessitate an entirely new viewpoint in modern foremanship.

In some respects I agree with him and give him credit for the courageous way in which he makes his denouncements, but it must be stated that the functions left for the modern foreman are still of an extremely varied character.

Probably one of the most important is in securing the greatest efficiency in his department. It is his duty to direct the operations of the workers so that the output will be large in quantity and high in quality. To produce the right thing at the right time and the ability to concentrate at will on any subject in the shop are essentials to modern foremanship.

In the engineering industry, as in others, there have been many efficient foremen in the past who have been illiterate. I have known a few, but today an ignorant man would never be contemplated by employers for a foremanship or respected by the workers if appointed.

In our industries today many qualities are required in a foreman for successful leadership, namely, character, method, resourcefulness, foresight, confidence, courage, patience, perseverance and tact, together with judgment, inventive faculty, wide practical experience and sound theoretical knowledge backed by initiative and organizing ability. He must thoroughly understand human nature, for this knowledge is necessary in leading and directing those under his control.

Speaking generally his task may be regarded as being to show the way and to see that those whom he directs go that way. He should be responsible for the quality of material and workmanship that his department produces and be well versed in all shop methods. He should see that the workers are never kept waiting for material and that the work is placed to the best advantage.

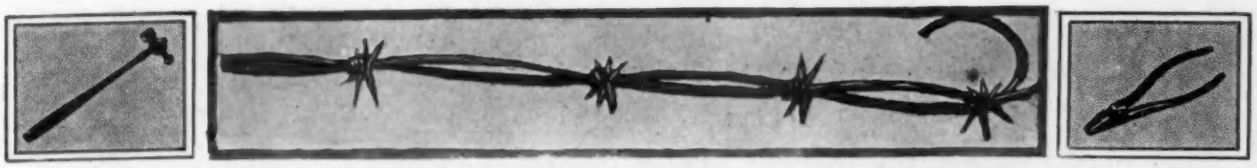
Furthermore, he must command the respect of the workers and be ever ready to coöperate with them to further the interests of his employers; in fact the essence of good foremanship, as of good leadership, is coöperation. The foreman who possesses and exercises the essentials of leadership will have loyal and efficient workers. They will be with him rather than under him. Also they will do their best for him because he understands their habits, temperament and adaptability.

Successful leadership requires the exercise of authority, and no foreman can exercise authority effectively without confidence in himself. Frequently prompt and clear decision is needed, and without confidence in one's own knowledge and judgment it will be impossible to give such decisions. Indeed nothing is more surely fatal to leadership than hesitancy and indecision.

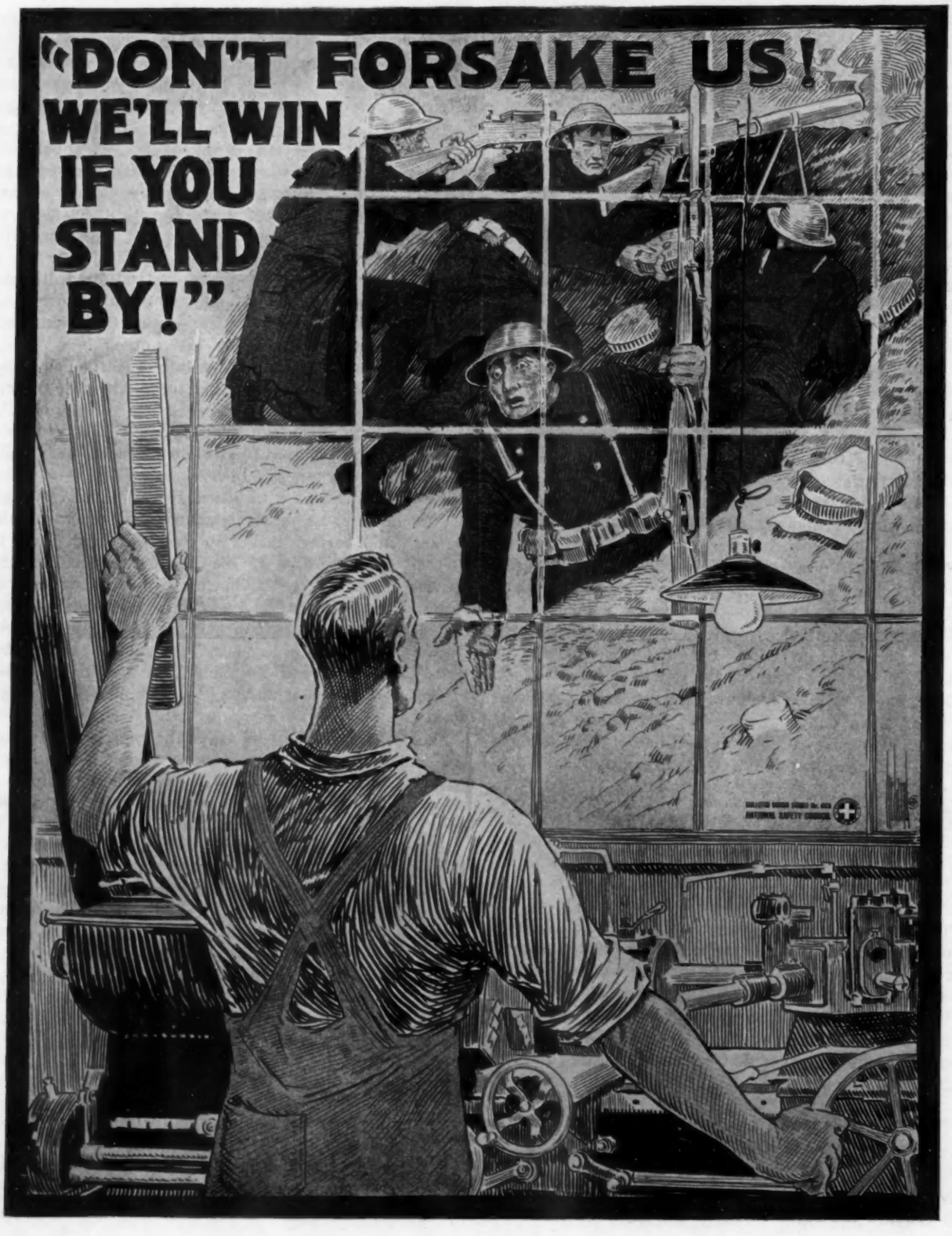
Finally, with the ever-growing cry for the organization of industry, it is evident that industrial leadership in the near future will be closely associated with better working conditions. Shorter working hours, for instance, is an economic as well as a social question. As a social reform a shorter day may be adopted, but it will have to justify itself economically to obtain and maintain productive efficiency in manufacturing.

Errata

In our article on "The Manufacture of the Sperry-Type Automobile Radiator," page 522, the word descriptive of the radiator should have been spelled "Spery." The company's name should also have been the Hooven Radiator Co., Chicago.



you and your men because you knew how to make cartridges. That is, if you can call the slavery that



followed being spared! Back you went to the shop, guarded by Prussian hounds who with curses

Repairing Locomotive Fittings

By FRANK A. STANLEY

THE tools here illustrated are a few of many similar devices used in the shops of the Southern Pacific Co. at Sacramento, Calif. Fig. 1 shows a self-feeding reamer for reclaiming worn distributing valve bushings in air-brake equipment, and Fig. 2 shows all parts of the tool in detail.

This tool, which is adapted for self-feeding through the work, is made up of a central body, or mandrel, *B*, 16⅛ in. long and 1½ in. in diameter, except for the enlarged portion, which carries the reamer proper, and at the outer end is a fine thread for feeding it through a guide nut while at the rear end is a coarser thread for receiving and adjusting the nut which sets the reamer up on the taper at *C*.

The reamer proper is shown at *D*, and like all other parts of the tool it is also shown distinctly in Fig. 1

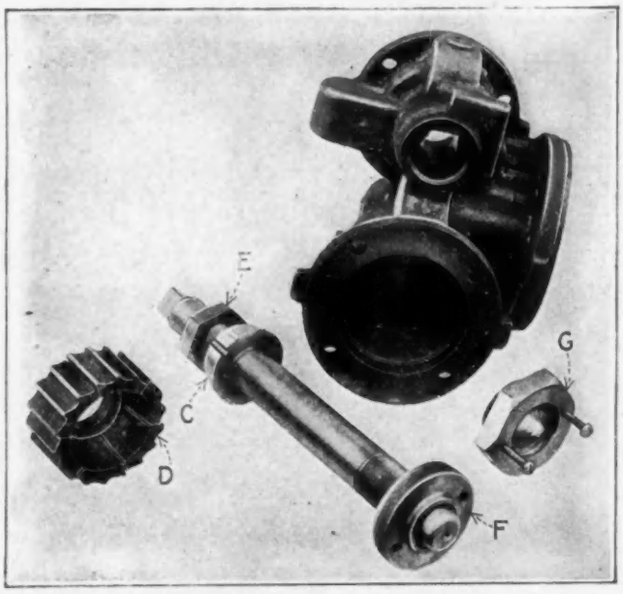


FIG. 1. A 4-IN. EXPANDING SELF-FEEDING REAMER

in front of the distributing valve which is to be overhauled, the same reference letters being used on both illustrations for convenience in comparison.

Upon referring to Fig. 2 it will be seen that the conical body *C* is a taper of 4 in. to the foot. The thread for the adjusting nut *E* at the rear is 12 per inch. One complete turn of the nut therefore means the equivalent of an expansion of the reamer of 0.0277 inch.

The reamer *D* has 18 teeth milled to a depth of $\frac{3}{16}$ in. and six $\frac{1}{16}$-in. saw cuts are run through from end to end as shown. Except for a distance of ½ in. at the rear face the saw cuts are carried down to the bore so that there is a good opportunity for the reamer to expand with close uniformity for the greater portion of its length.

Midway of the face there is a ¼-in. pin inserted to enter a groove of the same width in the conical body *C*, on which the device is mounted, to provide against the rotation of the tool upon its seat.

Near the leading end of the mandrel *B* there is a fine-pitch thread (40 per inch) which receives the feed

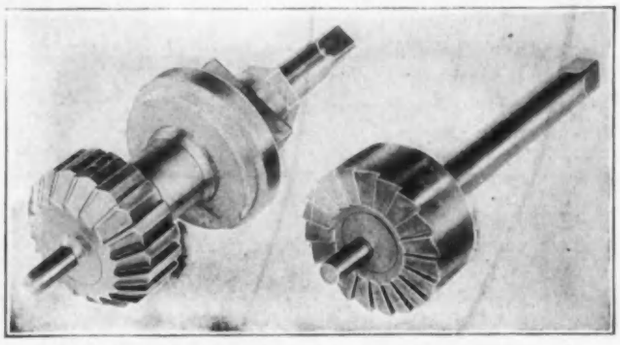


FIG. 3. HAND REAMERS FOR STEAM TURRET

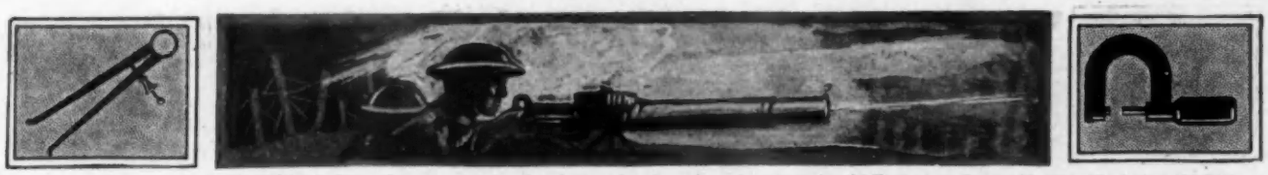
nut *F*. This is a bronze nut with knurled edge and with a shouldered face to seat in a counterbored recess in the corresponding face of the steel guide nut *G* when the tool is assembled. The two nuts are then secured together by two ¼-in. button-head screws which pass through body-sized holes in the bronze feed nut and enter tapped holes in the steel guide nut.

In use the steel guide nut is screwed into the end of the distributing-valve casing by removing the cap plug, and this brings the feed nut into alignment with the bushing to be reamed so that when the reamer is run into place wit its threaded inner end entered through the feed-nut thread the mandrel is correctly positioned for the passing of the reamer through the bushing.

On applying a wrench to the squared end of the reamer shank the tool is drawn forward through the work at the rate of 0.025 in. per revolution.

The reamer proper fits upon a reverse taper on the body so that the expansion of the tool is obtained by the adjusting nut at the rear, against which the thrust of the reamer is taken so that there is no tendency for the reamer to expand under the cut as might occur under certain conditions of usage if the small end of the cone were forward and the reamer consequently pressing back against an enlarged taper center.

Another set of hand tools is shown in Figs. 3 and



and thrusting bayonets forced you to dismantle the shop and to load the machinery on railroad cars.

4 for finishing steam-turret or fountain valve seats. The tapped opening through which the valve-reseating tools must enter is 4¼ in. Both the flat facing cutter *K* and the angular seat reamer *L* are formed with 19 teeth and both are adapted to fit onto the threaded end of a shank *M*, Fig. 5. The shank for each cutter has a pilot ½ in. in diameter to enter the valve-guide hole under the steam turret and so align the tools properly for the cut. The shank or mandrel for the angular seating tool is also provided with a threaded sleeve *N* which is bored out 0.003 in. larger than the body of the tool to allow the latter to rotate properly. The thread on this sleeve is adapted to carry the nut *O* which serves as a feed nut. The feed nut is screwed into the 4¼-in. tapped hole in the top of the steam turret, and the sleeve *N* is then turned by its squared portion to feed the tool downward against the work. The tool is shown assembled at the left in the drawing, Fig. 4, and also in the illustration, Fig. 3. The group of tools illustrated in Figs. 5 and 6 are used for the repair of lubricators. The lubricator parts taken care of by the tools shown are the feed nozzles, regulating valve, water valve, auxiliary steam-valve bonnet and nut and numerous other fittings and connections. The uses of the special drills, counterbores, conical reamers, taps and dies will be apparent to the reader.

There are various valve seats in the lubricators made with a 30-deg. angle. These valve seats become worn in the course of time and the reseating of the surfaces is accomplished with the aid of a 30-deg. reamer like the one shown at the right side in both Figs. 5 and 6. Flat drills of the type shown at the bottom and left in Fig. 8 and in the lower right-hand corner in Fig. 5 are applied in finishing parts of the valve fittings and similar classes of attachments. Other fittings are taken care of by counterbores and facing tools of the

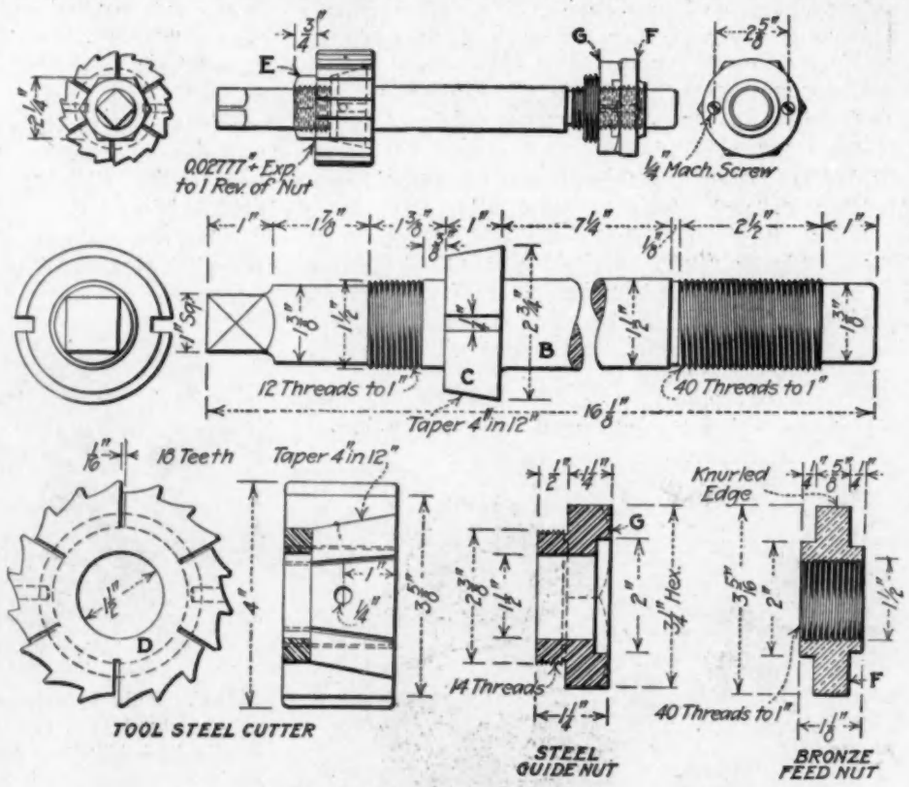


FIG. 2. THE REAMER MEMBERS

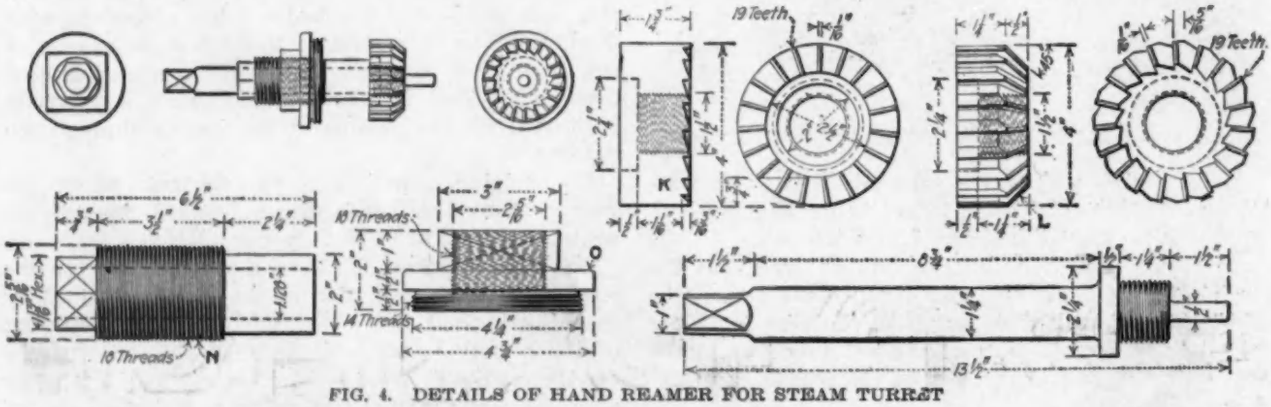


FIG. 4. DETAILS OF HAND REAMER FOR STEAM TURRET

Crowded into a stinking cattle-car and without food or water for two days and a night you were

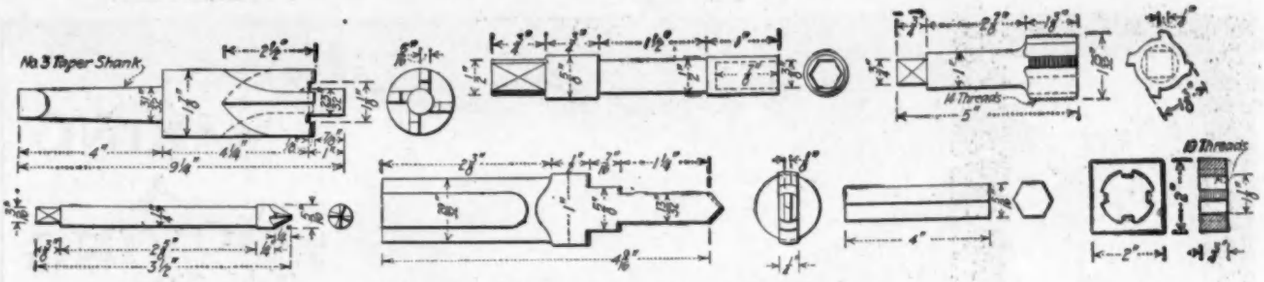


FIG. 6. DIMENSIONS OF LUBRICATOR TOOLS

general form represented at the extreme left in Fig. 5, a detail of which is included in the drawing, Fig. 6.

The expanding reamer in Fig. 7 is applied to the saving of worn-out bushings in various sizes of triple valves for air-brake equipment. While constructed along similar lines to the reamer in Fig. 1 there are various points of difference that make it worth showing.

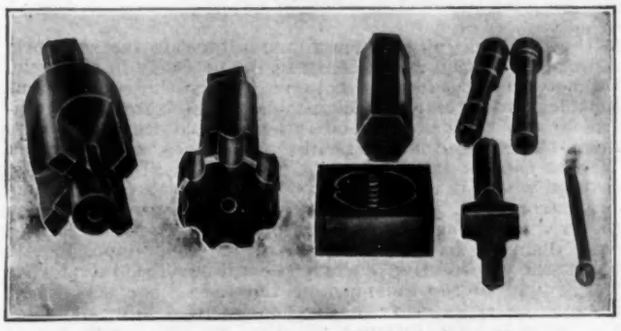


FIG. 5. TOOLS FOR REPAIRING LUBRICATORS

This particular reamer is applicable to numerous classes of valves by merely changing the guide nut, a feature indicated by the detail drawing, Fig. 8, where three different sizes of guide nuts, *A*, *B* and *C*, are included, all used as required in connection with the one reamer bar and reamer.

The feed nut is provided with a pair of ¼-in. holes for two machine screws which are used to fix the nut to whichever guide nut is required, the tapped holes in the latter all occupying a definite position at uniform distance from the center to allow them to be used

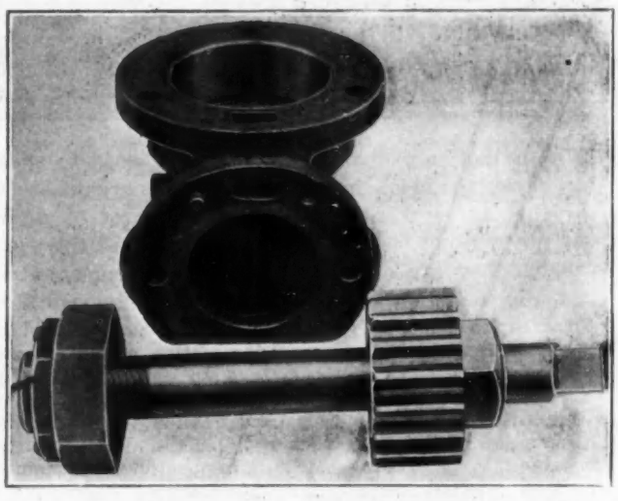


FIG. 7. ADJUSTING REAMER FOR TRIPLE VALVES

interchangeably in connection with the main feed nut. It may be noticed that while the thread for feeding the reamer through the bushing is the same as that used on the reamer in Fig. 1, there is a difference in the pitch of the adjusting thread behind the reamer proper, the thread on the reamer being 18 pitch.

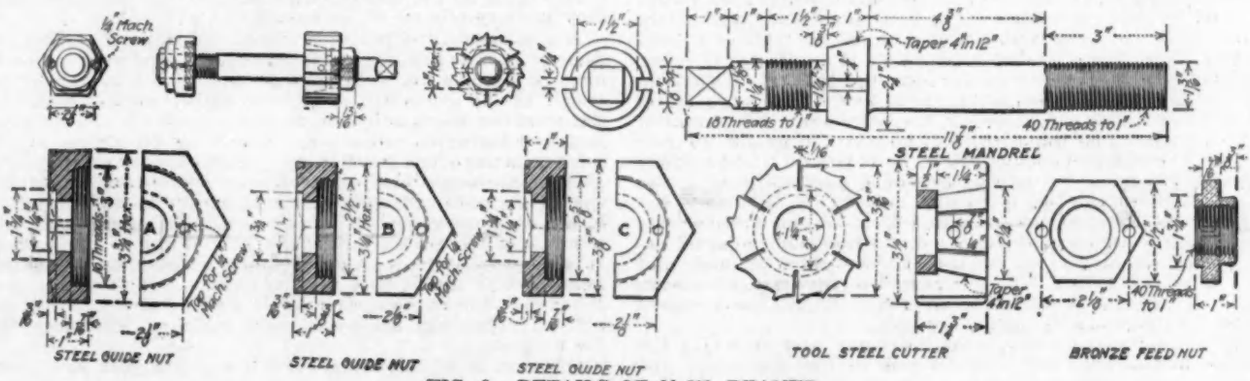
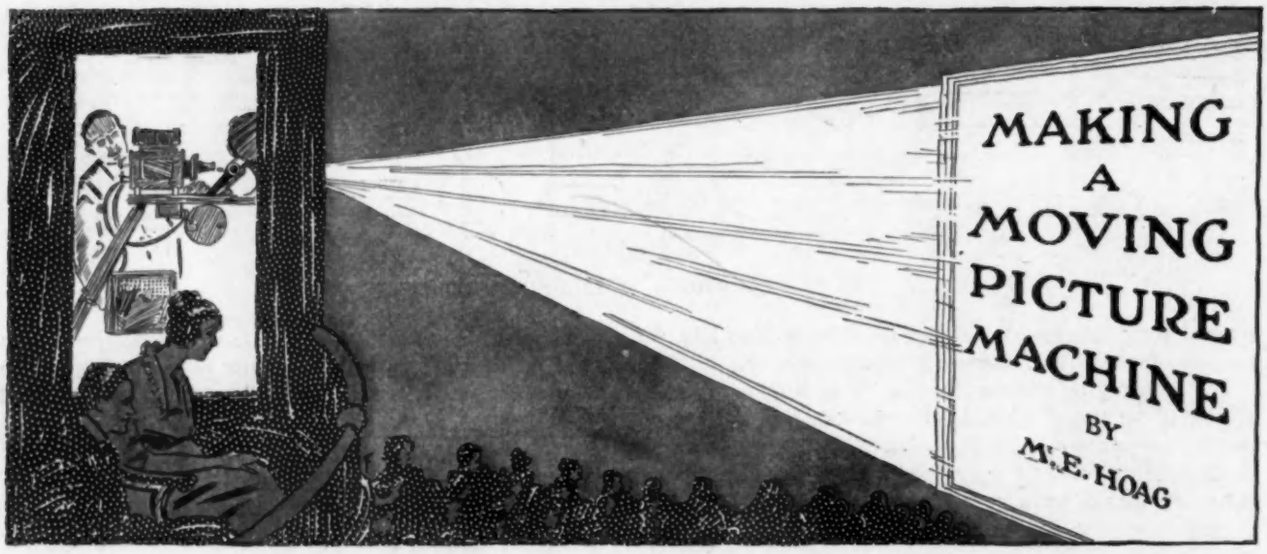


FIG. 8. DETAILS OF 3½-IN. REAMER

brought to the enemy's country. After you had helped to set up on German soil the machinery from



MAKING A MOVING PICTURE MACHINE

BY M. E. HOAG

THE motion-picture machine can be used to such advantage in the factory and the sales organization that a few words from a manufacturer of these machines will not be amiss. To show some of the uses to which they are adapted I will quote from a letter written by A. F. Victor of the Victor Animatograph Co.

Dear Sir: It is only within the last few years that the public has realized the value of the motion picture as an aid to education. While it is natural to look upon it as a source of entertainment, sufficient credit has not been given to this invention for its more serious mission. I will briefly outline a few of the many uses to which the motion-picture projector may be put, especially its application to machine-shop and mechanical-engineering problems.

There are many machine operations which may be much better analyzed if a motion picture is made and examined with the care and deliberation offered by this means and in which each individual motion may be arrested and examined separately. It is by means of motion pictures that we have been able to analyze the loss of time in improperly handling materials and tools. It has even been possible to cut out with a pair of scissors such portions of the film as represent the wasted effort of the operator, unite the separated parts and project the revised record of the operations as they should be performed. It has been possible to reconstruct a series of movements in this manner and accurately determine the time that could be saved by making needed corrections. We tried this at one time in our factory. After taking a picture record of the turning of a certain part we decided after repeated inspections that there were many superfluous motions made by the operator. We trimmed the film down to what we thought was the proper number of movements and found that while it was at times slightly "jerky" it gave the appearance of a continuity of action and included all the necessary movements to insure the proper handling of materials and tools. Upon showing this film to the workman whose work had been under consideration he was able after looking at the picture a number of times to reproduce the reconstructed sequence shown on the screen and he subsequently reduced the time required for this operation by almost one-half.

This is but one example of the many uses to which the camera and projector may be put in the workshop, and individual needs and personal ingenuity will suggest other methods of utilizing this new-found adjunct to factory work. A word of caution is necessary to the beginner in this field. Do not overdo things. Photograph only those operations that demand attention. One should not seek for opportunities to use the camera, but rather should employ it only upon those subjects where its advantages are manifest. With a camera in the factory, problems will soon be discovered where it will prove to be the only solution.

A second and perhaps equally valuable use for motion pictures is to show machines in operation at points located at a distance from the factory when it is impossible to bring the prospective customer or interested investor to the ground to see the machine itself. I have somewhere in my files a letter from the Cincinnati Milling Machine Co., in which it informs me that a few years ago it was to meet some European buyers by appointment in New York. The machines to be shown were too complicated to be described by word of mouth and the ordinary photograph was inadequate to properly convey the idea of the movements. The buyers met the representative of the factory in New York, where the latter was able, by means of motion pictures, to show the machines to such advantage that the order was immediately placed.

In this case the motion picture performed a service that nothing else could have done. The buyers were unable to go to the factory; the machinery was too heavy to be moved at such short notice; but the motion-picture projector was able to convey to the men interested such a complete understanding of the intricate workings of the machine that they were convinced of its merits.

A motion-picture projector is of value in the office or factory as a means of entertainment. A half hour at noon may be devoted to pictures that amuse and entertain, to which should be added a picture which carries home to the working force a lesson of some kind. With the projected picture in motion, remarks that otherwise might seem trite are given force to carry conviction to the hearers. For instance, one may relate the manner in which an accident has occurred with resultant injury to an operative. If the occurrence can be reënacted, one will be able to explain to much better advantage how it comes to happen. It is easy to portray an accident in this manner by having someone who saw it pose for the picture. With one or two rehearsals the average man or boy in a workshop will be able to reproduce the scene with sufficient exactness for the purpose.

Often it is of advantage to show a prospect how your product is made, and you may take your raw material

your old Belgian shop you were ordered to go ahead and make cartridges for the Boches to fire against

and show the process step by step to completion. Not only does this impress the purchaser favorably, but during the projection of pictures of this kind the spectator's whole attention is focused upon the subject under consideration instead of being distracted by the thousand-and-one things that will intrude themselves when he has to listen to the talk of a salesman.

It is not easy in a short letter to outline the many uses to

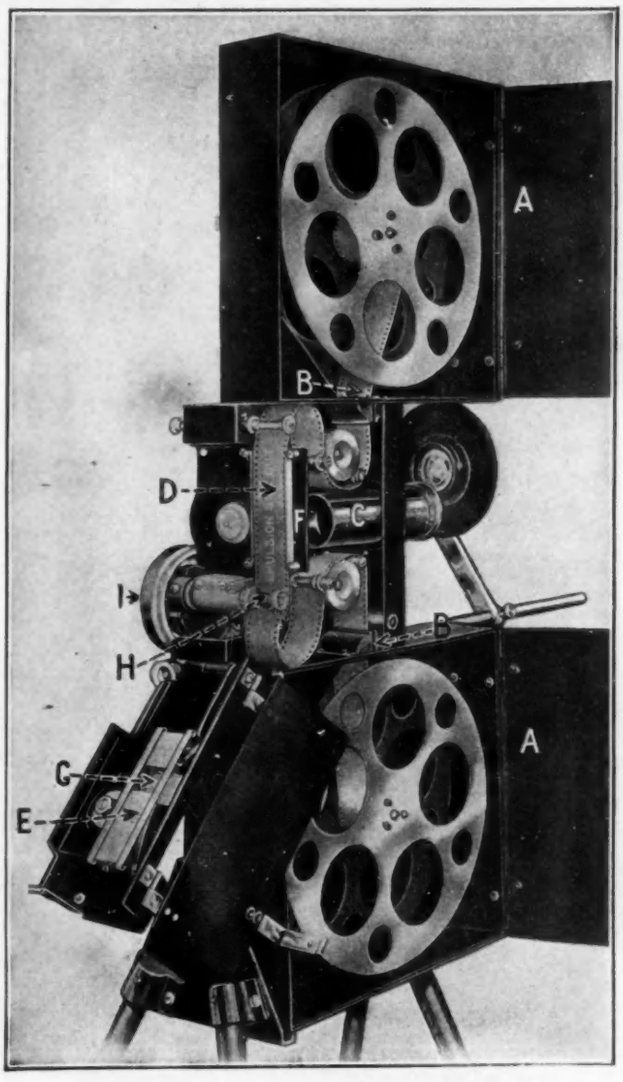


FIG. 1. MOTION-PICTURE MACHINE

which the motion picture lends itself in this field, but the few examples cited will indicate the possibilities of the method which may be worked out according to each individual need.

A. F. VICTOR.

The human eye is incapable of recording more than 16 impressions a second without having these impressions or vibrations assume the appearance of continuous motion and it is on this law that the motion-picture projector is based. This means that the ribbon of the film must be stopped and started 16 times a second and that the shutter movements must be double this, or 32 movements a second, in order to break up the flicker which was so evident in the earlier motion-picture machines. It also means that the period of movement of the film must be short in comparison with the period of rest, otherwise the picture will not be sufficiently lighted, as the light is allowed to pass through the film only during the period of rest. Owing to the great magnification of the film image on the screen, great accuracy is required in order to secure the exact register of each picture on the film, otherwise the picture on the screen will appear to jump about and will produce a very tiring effect on the eyes of the spectators. It will be seen from the foregoing that

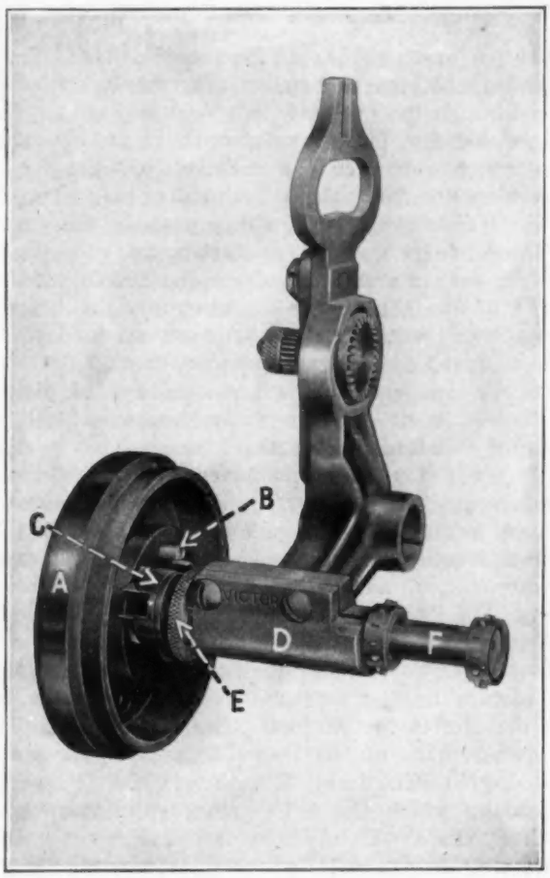


FIG. 2. THE INTERMITTENT-GEAR MOVEMENT

very accurate work is required in the construction of the machine.

I am indebted to the Victor Animatograph Co., Davenport, Iowa, for the photographs and information contained in this article, and while some of the methods and tools may not at first sight seem as efficient as

your brothers. Do you remember what happened to those who refused? Do you remember the man

they might be, it must be borne in mind that the relatively small number of motion-picture machines sold every year, together with the constant improvements and changes, make the use of intricate special machines and tools impractical from an economical standpoint.

The general construction of the Victor Animatograph is well shown in Fig. 1. The films on which the pictures are made are of celluloid and are very inflammable; therefore, to avoid accidental fires and loss due to destruction of a valuable film, fireproof cases *A* are required for the reels of film. These cases are fitted with automatic fire traps at *B*, so that should the short length of exposed film take fire, these traps will prevent the flame from entering the cases, and the resultant loss will be but a foot or two of film.

Method of Operation

When operating the machine the reel of film is placed in the upper chamber and the end threaded down through the machine, as shown in Fig. 1. Each edge of the film is perforated with accurately spaced holes which run over the sprockets of the feeding mechanism in about the same manner as a sprocket chain or link belt, thus making possible the correct mechanical functions, such as starting and stopping the film for each picture flashed on the screen, and the timing of the shutter which interrupts the beam of light. As all motion-picture films are of standard size with standard dimensions and number of holes along the edges, and carries the same number of pictures per foot of length, they are interchangeable in all machines of standard manufacture.

The light for these machines is supplied by a nitrogen-tungsten lamp of special construction, which requires less skill to manipulate successfully than the arc lamps used on some of the larger machines, and is therefore better adapted to factory use than are the others.

The projection lenses are carried in the tube *C*, which is telescopic and provides means for focusing the picture on the screen. Between this lens tube and the film is the shutter. The film *D* is held flat by springs back of the frame *E*, pressing it against the piece *F*. The frame *E* has a window, or aperture, *G* through which the light passes and gives outline to the picture. This whole section swings up and incloses all moving parts of the machine when in operation and renders it as nearly light tight as is possible. Back of this part of the machine is the lamp bracket and condenser lenses, which latter, together with a suitable reflector condense the light rays and focus them on the film, thus securing practically the entire light efficiency of the lamp. As the heat from the lamp is also focused on the film it would catch fire if allowed to stop its motion, and to prevent this an automatic fire shutter is provided back of the frame *E*, which automatically closes as soon as the speed of the film is reduced to a certain point.

The starting and stopping of the film for each of the 16 movements a second is accomplished by the sprocket *H* and the mechanism at gear *I*, an enlarged view of which is shown in Fig. 2. The driving member

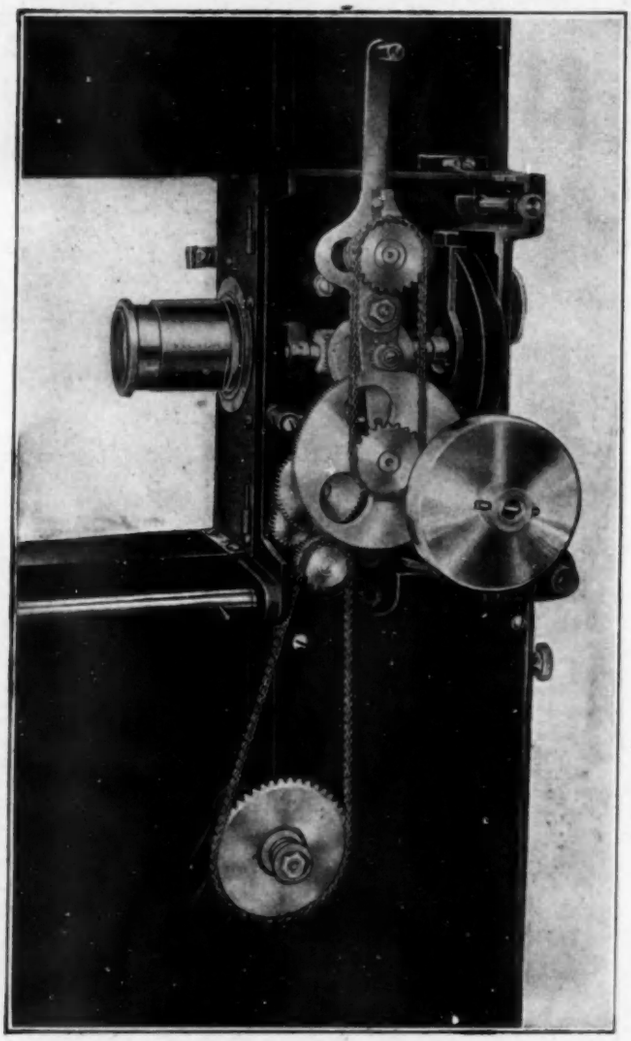


FIG. 3. DRIVING MECHANISM OF MACHINE

A carries a pin *B* which engages one of the openings in the three-point starwheel *C*. The bracket *D* carries an eccentric bushing *E* of phosphor bronze, which permits the raising or lowering of the shaft on which is mounted the starwheel *C* and the sprocket *F*. This is used to adjust the film with relation to the lenses and window before leaving the factory, and may be changed afterward if necessary. A third view, showing the back of the machine is shown in Fig. 3.

who with arm outstretched overhead was dropped into a pit dug by the Germans in the factory

Composition and Properties of Steels

BY HOWARD ENSAW

A dissertation on the compositions of steels used for the manufacture of the various parts of intricate special machinery, especially airplane engines, requiring materials possessing unusually high tensile strength and shock-resisting qualities. A study of the many steel alloys in common use will enable the manufacturer to select from among their number a few brands embodying the particular qualities essential to his product, and by concentrating his attention upon them he may reduce the element of uncertainty and consequent hazard that must necessarily follow a wider range of selection.

MOST branches of the engineering trades are at one time or another faced with the necessity of reducing the weight of some piece of mechanism. This applies particularly to the manufacture of automobiles and airplanes and forms probably the chief reason for a thorough study of the nature and properties of the materials employed in the construction of such mechanisms.

It is essential that the designer should have a full knowledge of the strength and durability of all the materials to be used, and it is important that those materials should be of a specified composition and that the treatment should be checked by suitable tests in order that the results in actual practice shall correspond with the data on which the designer worked.

Until about four years ago knowledge of the composition of aircraft steels and experience in their treatment was very limited; today there are so many brands of alloy steels requiring different treatment that great care must be exercised. As the hardening and tempering process is liable to error owing to the number of brands available, users are advised to choose as few types of steel as possible to cover their requirements. The treatment of the selected ones then quickly becomes familiar and the possibility of error is reduced.

A range of about ten steels will cover practically all requirements and the object of these notes is to give the composition and properties of a range which may be chosen to advantage.

As variation in heat treatment is required with different steels in order to obtain the best results it is necessary to consider the mechanical properties along with the chemical composition. It is possible, however, particularly in the case of nickel-chrome steels, to obtain widely varying results with varied heat treatment.

The following table has been compiled from actual tests made with a particular make of nickel-chrome oil-hardening steel and illustrates this point very well:

O. H.	T.	Time	T. S.	R. A. Per Cent	B. N
825	650	30	59	57%	269
825	600	30	64	48%	286
825	550	30	69	42%	321
825	500	30	75	43%	332
825	450	30	85	42%	375
825	450	20	87	49%	364
825	400	30	96	38%	418
825	350	30	104	33%	430
825	200	15	121	38%	512
825	not	tempered	123	34%	477
825	not	tempered	126	21%	512
800	not	tempered	127	27%	477

O. H. = Temperature in degrees Centigrade at which sample was hardened in oil.
T. = Temperature in degrees Centigrade at which sample was tempered.
Time = Time in minutes for tempering.
T. S. = Tensile strength in tons per square inch given by test piece.
R. A. = Reduction of area registered during above test.
B. N. = Brinell hardness number.

The material which gave the above tests when treated in the manner indicated forms the basis of a most interesting metallurgical study and is of exceptional value in aircraft work. It will be noticed that various degrees of hardness can be obtained, and this factor is of special utility in the manufacture of articles where distortion is a disadvantage and at the same time difficult to avoid.

The articles are first rough-machined and then heat-treated to a Brinell hardness of 250 to 321. At this hardness the articles can be machined and we then have no distortion in the finished goods as there is no subsequent heat treatment. It will thus be seen that it is possible to obtain widely varying results from one brand of steel, and it might also be said that it is possible to obtain similar results from two steels of widely different chemical composition.

It is advisable that the steel manufacturer should cooperate to a greater extent with the steel user to obtain a better understanding of the work which the finished article has to perform. Items subjected to different stresses require different materials and treatment, and in the case of resistance to wear it is well to bear in mind that a steel containing low proportions of nickel and chromium will resist wear better than a steel containing a high proportion of nickel and no chromium.

It has become generally recognized that it is not only necessary to utilize materials of a sufficiently high yield point but the materials must also be of a nature suitable for resisting wear if the articles are subjected to abrasion and able to withstand shock if the articles are subjected to vibration. The advisability of putting samples of the materials through tests which bear some resemblance to the stresses which will be met in actual use is obvious, and in connection with airplane-engine manufacture this question has been given considerable attention.

Perhaps the first decision to be reached in the manu-

yard, and how the earth was shoveled into this pit, burying him by inches? Do you remember how

facture of parts which are highly stressed is in relation to the composition of the materials employed. It will be understood that if the material should be of incorrect proportions satisfactory results can hardly be expected.

It is expensive to introduce nickel, chromium, manganese and vanadium into mild steel, and unless the alloy thus produced is carefully watched its value may be destroyed as the result of incorrect proportions of carbon, sulphur and phosphorus. A full chemical analysis from time to time is necessary to preserve equality of product.

In addition to the expense of manufacture, alloy steels require more careful treatment and a scientifically arranged system of checking temperatures is necessary if the results are to be relied upon. As the employment of these steels is necessary when we require an ultimate strength reaching to 130 tons per square inch the expense of materials and testing apparatus must be met.

Difference in Treatment

The alloys differ widely, and the treatment of these various alloy steels must be modified to suit each particular composition. When nickel is added to plain carbon steel the skin of the hardened material is harder and the depth to which the quenching effect penetrates is greater. Chromium and tungsten added to plain carbon steel enable a more highly finished surface to be obtained when machining, and a finer grain is produced in the metal, but these elements do not appear to materially influence the hardness or the depth of case of the hardened material. Chrome-vanadium steels do not appear to have given quite as successful results as nickel-chrome steels, but for certain purposes they are preferable.

The presence of vanadium increases the depth of the hardening effect, but when vanadium is present, even in moderate quantities, the material in the annealed state is very hard and machining difficulties arise.

Nickel is perhaps the most valuable element to the metallurgist, and by simply normalizing a bar of nickel steel to the same tensile strength as a sample of medium-carbon steel a comparison of the results readily establishes the superiority of the alloy steel. Increased elasticity is obtained and the impact-test figures are considerably improved, so that in cases where elasticity and shock-resisting qualities are required nickel steel is preferable, providing the carbon content is not excessive in proportion to the nickel. If the carbon content is not within the limits that will be specified later the probability is that the article would fracture under a lighter load than would plain carbon steel.

Bearing in mind the influence of these alloys when introduced into steel we can proceed to inquire into the composition of the materials, and it must be noted that it is necessary to maintain the proportions of the elements within certain limits in relation to each other.

The use of plain carbon steel in aircraft work is quite restricted, as we generally require material able to withstand higher stresses; but it can be used for certain parts which are not subjected to great shock or wear, such as tachometer gear. It is then possible to use a steel suitable for automatic machinery, and material of the following specification will be found to give satisfactory results:

	Per cent.
Carbon, not greater than	0.25
Manganese, not greater than	0.85
Silicon, not greater than	0.20
Phosphorus, not greater than	0.06
Sulphur, not greater than	0.06

Should it be required to use a slightly higher tensile steel the following proportions will be found satisfactory, but machining is more difficult and the tools will require more frequent attention:

	Per cent.
Carbon, not greater than	0.40
Manganese, not greater than	1.00
Silicon, not greater than	0.20
Phosphorus, not greater than	0.06
Sulphur, not greater than	0.06

Neither of the above steels are suitable for case-hardening, but as they can be obtained in bright drawn bars the advantages of their use in all possible instances are obvious. Although casehardening nickel steel has in many cases taken the place of casehardening mild steel the latter is still used to a great extent in the manufacture of valve tappets, engine-timing gears, camshafts, gudgeon pins, etc. Parts made from this material present a good resistance to wear, and two qualities, low and medium carbon, may be used with advantage. The low carbon will give a minimum of 23 tons breaking strength when normalized at 900 to 920 deg. C. and the composition as follows:

	Per cent.
Carbon	0.10
Silicon	0.18
Manganese	0.60
Sulphur	0.04
Phosphorus	0.04

When this material is normalized as above, the physical tests should be as follows:

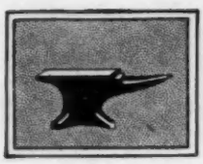
Breaking strength	23 to 28 tons per square inch
Yield ratio	Not less than 50 per cent.
Elongation	Not less than 30 per cent
Reduction of area	Not less than 50 per cent.
Brinell hardness	92 to 112

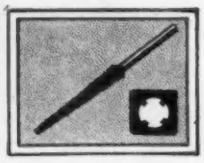
This material, if well made, will be found to case-harden well and uniformly, but it is frequently necessary to employ a similar steel with slightly improved breaking strength, although there is a tendency for the elongation to diminish.

This second-quality casehardening mild steel can be specified as follows:

	Per cent.
Carbon	0.15
Silicon	0.18
Manganese	0.75
Sulphur	0.06
Phosphorus	0.06

It will be noticed that higher proportions of sulphur and manganese are permissible in this instance. When





when the earth reached his knees and again his waist, and again when it reached his neck, the

the above material is normalized at 890 to 920 deg. C. the following tests should be obtained:

Tensile breaking strength	25 to 33 tons per square inch
Yield ratio	Not less than 50 per cent.
Elongation	Not less than 25 per cent.
Reduction in area	Not less than 50 per cent.
Brinell hardness	103 to 143

The normalizing temperatures given are within 50 deg. C. above the critical temperature in each case.

The carburizing should take place at 900 deg C., the length of time depending upon the depth of case required, and the articles should then be allowed to cool down in the compound. In order to refine the structure of the case the articles should be heated to about 870 deg. C., and either allowed to cool in the air or be quenched in water. Finally they should be reheated to 780 deg. C., and quenched in water to harden the case.

With certain makes of steel not conforming correctly to the above specifications it may be necessary to depart very slightly from the above temperatures, but the most suitable conditions can readily be ascertained by trial and a little advice from the steel maker.

There are many instances where it is necessary to have some knowledge of the properties of the core of casehardened articles, and this can be obtained by putting test pieces through the same heat treatment and at the same time as the parts being manufactured, and turning off the case to the depth to which the carbon has penetrated. It will generally be found that by the refining influence of the heat treatment the yield point and the breaking strength are improved and that the elongation and reduction of area are reduced.

In some recent tests in connection with the last-named material the tests on the material as rolled and after the hardening treatment were:

	As rolled	After treatment
Breaking strength	31 tons	36 tons
Yield point	21 tons	25 tons
Elongation	28 per cent.	23 per cent.
Reduction of area	58 per cent.	51 per cent.

These figures are of value, as it must be realized that we cannot rely on the case to withstand shocks and our calculations must consider the extent to which the material may be loaded, based on the strength of the core only.

Should circumstances arise where it is necessary to employ material of higher ultimate strength and better surface-wearing qualities than the casehardening carbon steels detailed above, use can be made of casehardening nickel steels, and here it is necessary to exercise greater care in manufacture and heat treatment.

A good low-nickel alloy steel can be made up as follows:

	Per cent.
Carbon	0.13
Silicon	0.25
Manganese	0.45
Sulphur	0.04
Phosphorus	0.04
Nickel	2.00

The carbon content must be carefully checked, for if excessive it will cause shortness, and attempts to straighten parts which may become distorted in hardening will result in fracture.

This material when normalized at 850 to 900 deg. C. should give the following results:

Tensile breaking strength	25 to 35 tons per square inch
Yield ratio	Not less than 55 per cent.
Elongation	Not less than 30 per cent.
Reduction of area	Not less than 55 per cent.
Brinell hardness	103 to 153

A step higher in tensile breaking strength and yield ratio can be obtained with an alloy steel containing a larger proportion of nickel and the elongation will remain about the same.

A chemical analysis of such a steel should show the results given below, and the necessity for maintaining a low proportion of the injurious elements renders the manufacture of this steel somewhat difficult and consequently expensive:

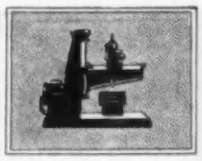
	Per cent.
Carbon	0.15
Silicon	0.18
Sulphur	0.04
Phosphorus	0.04
Manganese	0.35
Nickel	5.00

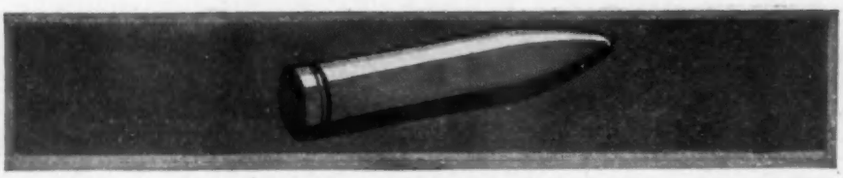
The casehardening nickel steels given above are suitable for articles where a good, hard wearing surface is necessary, but when quenching to harden the case it is necessary to reheat to a somewhat lower temperature than is the case with carbon steels. When it is decided which brand of material to use it is advisable to carry out a series of tests to ascertain the most suitable temperature.

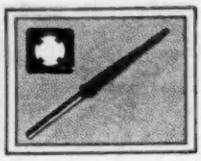
Occasionally it is necessary to manufacture articles where good wearing qualities are required, but the parts are so thin that a hard case would be disastrous as there would be no core left. In such instances an alloy steel containing about 3 per cent. nickel, 0.30 per cent. carbon and about 0.70 per cent. manganese will be found of great value as it is thus possible to obtain 45 tons per square inch ultimate stress and a Brinell hardness of about 200.

The materials which have probably been of greatest value to the automobile manufacturer engaged on airplane-engine work are probably the alloy steels containing nickel and chromium in their composition. These alloys can be so constructed that they can first be hardened and then tempered to give almost any degree of hardness between 250 and 500 Brinell, and it is not a difficult matter to bring the hardness to about 320 Brinell. Up to this figure the material can be machined and the parts will stand a great deal of shock and wear, but should the hardness be greater the probability is that the further machining would be impossible.

It must not be concluded from the above remarks that the Brinell-hardness numeral can be taken as a general guide to the machining properties of materials, but in comparing two samples of the same steel it can be taken as a rough indication. When comparing different







devils asked him "Schweinhund, bist du bereit arbeit zu beginnen?" ("Swine, are you ready yet to

alloys it is quite possible that one steel can easily be cut by another which registers lower on Brinell test.

A high-tensile nickel-chrome steel, suitable for tempering to various degrees of hardness can be built up as follows:

	Per cent.
Carbon	0.20 to 0.30
Silicon	Not over 0.30
Manganese	0.35 to 0.60
Sulphur	Not over 0.04
Phosphorus	Not over 0.04
Nickel	2.75 to 3.50
Chromium	0.45 to 0.75

If the above material be heated up to 820 deg. C.,

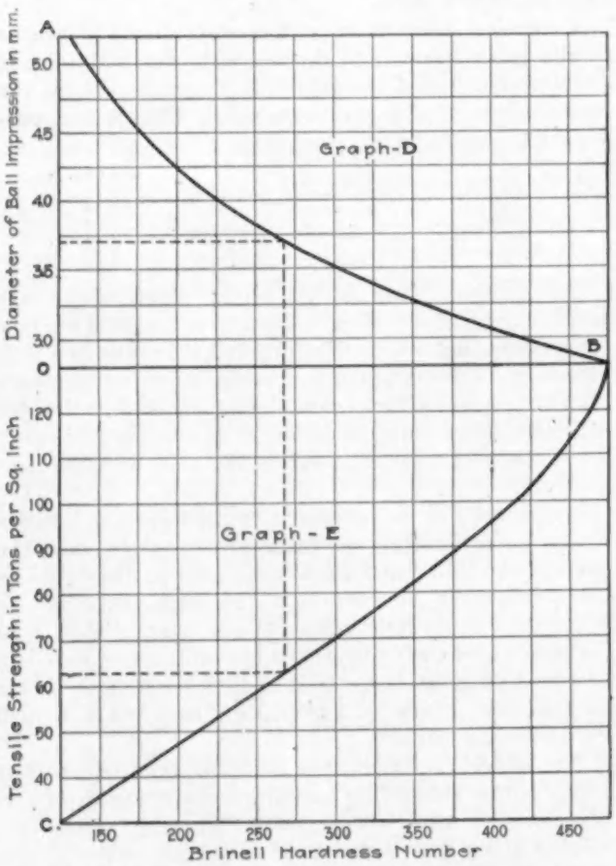


CHART FOR DETERMINING TENSILE STRENGTH

quenched in whale oil and then tempered at 600 deg. C. the test results should be approximately:

Tensile breaking strength	Not less than 45 tons per square inch
Yield ratio	Not less than 75 per cent.
Elongation	Not less than 15 per cent.
Reduction of area	Not less than 50 per cent.
Brinell-hardness number	179

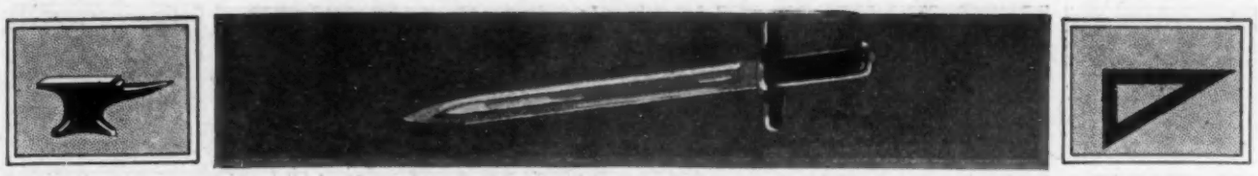
When using this material for a high-tensile strain and a hardness of about 320 Brinell, as previously suggested, it is an advantage to rough out the parts before heat-treating so that very little metal is left for removing in the hard state.

In connection with hardness and ultimate strength we often find attempts made to establish a law in which the two qualities are related. I have found that it is not correct to look upon the Brinell-hardness test as a measure of tensile strength when comparing materials of different composition, but when comparing the same brand of material treated to different degrees of hardness there is reasonably close connection between that hardness and the ultimate strength of the material in the same state.

Some elaborate tests were made to ascertain this relation in the case of an alloy steel containing a moderate proportion of nickel and chromium, and by plotting the results of a Brinell test and tensile test on various heat-treated samples the chart here shown was prepared. For that particular quality of material it was found possible to ascertain the tensile strength with a reasonable degree of accuracy after simply measuring the diameter of the impression left by a 10-mm. ball under a pressure of 3000 kg. on the Brinell machine.

It is simply necessary to locate on axis *OA* the position indicating the impression diameter in millimeters, and from that point travel horizontally to the curve in graph D, then vertically across axis *OB* to the curve in graph E and by traveling horizontally to axis *OC* we obtain the approximate tensile strength.

**Will you listen to him—
or help Uncle Sam?**



work?") Do you remember when the head disappeared under the earth and all that remained in

Making Americans on the Railroad

BY SAMUEL REA
President Pennsylvania Railroad System

This statement was furnished by Mr. Rea to the Hon. Franklin K. Lane, Secretary of the Interior, following the Americanization Conference called by Mr. Lane and held at Washington. It tells some of the methods adopted and results achieved in persuading and fitting foreign-born employees of the Pennsylvania R.R. to become loyal and useful citizens of the United States.

AS ONE of the largest employers of labor in the United States the management of the Pennsylvania Railroad System has naturally felt keenly the importance of adopting practical means for encouraging the Americanization of as many as possible of its foreign-born employees. This subject has, in fact, for a long period occupied a most important place in the labor policies of the system.

The task of producing good United States citizens from the millions of men and women of alien birth who are in this country, and who in normal times come here by the hundreds of thousands yearly, appears to resolve itself into two problems:

First, America must be made to seem to these people a good place not merely to make money in but to live in. Second, they must be induced to give up the languages, customs and methods of life which they have brought with them across the ocean and adopt instead the language, habits and customs of this country, and the general standards and ways of American living.

Had the solution of these problems of assimilation been successfully achieved along broad lines in the past, possibly there would not for so long a period have been witnessed the familiar phenomenon of large numbers of foreigners coming to this country, working a few years and then returning with their savings to live in their native lands. Nor would there today be foreign colonies in all American cities, and distinctively foreign areas of agricultural settlement in other portions of the country. In short, the dream of the "melting pot" would be realized in the America of today.

How far that dream actually is from realization is only too clearly attested by the unfortunate fact that in many of the typical foreign colonies of American cities—such as Italian, Greek, etc.—even the second and third generations still remain distinctively Italian or Greek, speak the languages of those races more readily than English, and substantially are foreigners, though born and living in America.

The management of the Pennsylvania Railroad System has consistently endeavored to solve the problem of Americanizing its foreign-born workers along purely practical lines, having in mind the two chief points of successful assimilation mentioned. In addition to the important patriotic considerations involved, which alone would unquestionably more than justify all the efforts made in this direction, the Pennsylvania management believes that it is in the highest sense good business to persuade and assist foreign-born employees to become citizens of the United States.

The task has proved to be one of very considerable magnitude, as may be judged from the fact that there are at present, on the whole system, both east and west of Pittsburgh, over 33,000 men of foreign birth.

Before the war this number was greater by some thousands. It has been very materially reduced, of course, by the large number of unnaturalized foreigners—principally citizens or subjects of the Allied governments—who have in the last three years returned to their homes to take part in the defense of their respective countries.

This drain on the supply of foreign-born laborers has, in fact, been one of the most serious difficulties encountered in maintaining a sufficient working force under war conditions.

DISTRIBUTION OF ALIENS

On the Pennsylvania lines east of Pittsburgh at the present time about 16 per cent. of the total employees are of foreign birth. On the lines west of that city, operating chiefly in Ohio, Indiana and Illinois, the proportion is somewhat smaller, but it is still quite material. Of the more than 33,000 foreign-born men working on the entire system about 25,700 are employed east of Pittsburgh and 7500 west of that point.

Some years ago, prior to the commencement of the great conflict in which the United States is now one of the leading participants, a canvass was made of the alien employees on all portions of the Pennsylvania system. This investigation showed that Italians greatly predominated in numbers. Today they make up nearly one-third of all employees of foreign birth east of Pittsburgh. It was found also that large numbers of the Italians, while they could not properly be termed illiterate, since they could read and write their own language, were nevertheless unable to understand English at all, either in written or spoken form.

With the feeling, for these reasons, that Americanization work was more urgently needed among the Italians on the Pennsylvania R.R. than among the representatives of any other nationality, a correspondence course

sight was the hand? How the Germans waited in vain for this hand to give the signal of submission?

in Italian-English was inaugurated on the lines east of Pittsburgh.

This work was placed in direct charge of a native-born Italian, who is also a graduate of Yale and an enthusiast on the subject of Americanization. A similar course in Italian-English has also been established under the charge of a native-born Italian on the lines west of Pittsburgh.

The original purpose in establishing these courses was to make Italians who are largely employed in track-maintenance gangs more efficient workmen by teaching them the English language so that they might better understand the orders of their foremen. The language courses are also utilized to instruct the men in the proper use of their tools, and in the fundamentals of safety, health and sanitation to aid them in raising their standards of living. A night class in English is shown in Fig. 1. For this reason all of the language lessons beyond the most elementary deal with practical subjects. As the course advances the work consists largely in rendering from Italian into English brief instructions relative to the use of tools and implements and information regarding the proper method of laying and repairing track and the fundamental safety rules. One entire pamphlet is devoted to the use of signals and signal rules and two others to the use of track tools. Altogether there are eleven pamphlets in the Italian-English course, and the last one of the series is devoted to the subject of naturalization.

FIG. 1. A NIGHT CLASS IN ENGLISH

On Feb. 20, 1918, there were 4307 students enrolled in the Italian-English course on the lines east of Pittsburgh alone or more than one-half of all the employees of Italian birth working on that portion of the Pennsylvania system.

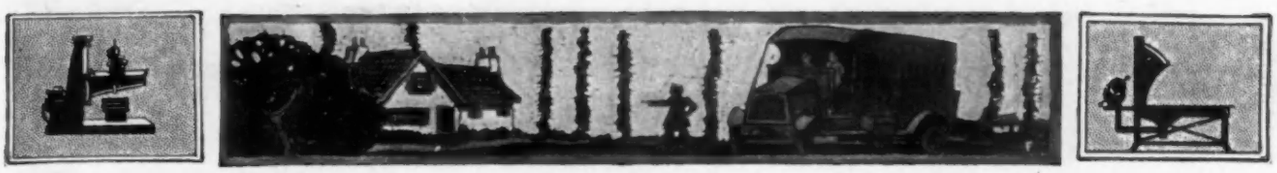
Experience on the Pennsylvania R.R. has shown that the best results in endeavoring to teach foreign-born employees the use of the English language are attained by measures which will practically compel them, in the course of their everyday work, to accustom themselves to speaking and thinking in the new tongue. For this reason information especially intended for employees of alien birth is usually printed in English instead of in their own language. Practically every gang of workmen has at least one man besides the foreman who can read English. Printed information in English is interpreted by him and explained to the others, so that the double purpose is served of imparting useful information and at the same time giving a language lesson.

In a similar way lectures on safety and similar subjects, while necessarily given at times in Italian and other foreign languages, are always accompanied by slides and other illustrations in which English is used.

After the first few months of the war, as is well known, the labor situation in this country became very acute, and it was necessary for the Pennsylvania R.R. to find and open up new and hitherto untouched sources of labor supply. After careful investigation a considerable number of Mexicans were induced to enter the service. They have been chiefly located along the main line between Pittsburgh, Philadelphia and New York. While they have been found efficient and satisfactory workman on the whole, they, like the Italians, were greatly handicapped by the fact that few could speak any language except their native tongue, which is Spanish.

To meet this condition, therefore, a special course in Spanish-English was prepared for the Mexicans similar to the Italian-English course. On Feb. 28, 1918, there were 451 Spanish-speaking employees learning English in this way.

The Mexican laborers have been chiefly concentrated in camps located at various points along the lines. All modern features to promote sanitation and health are adopted. In addition provisions have been made for amusements and recreation, including camp recreation rooms, Victrolas, etc. Instructive entertainments are given from time to time under the auspices of the Young Men's Christian Association. Wherever pos-



Do you remember the months that followed this, months in which for the first time you learned the

sible religious services for the Mexican employees are conducted under the direction of a Catholic church.

In addition to the language courses carried on through the educational organization of the Pennsylvania R.R., instruction is also provided, by correspondence, in electricity (including elementary mathematics) and in stenography. Altogether, out of approximately 166,000 employees on the lines east of Pittsburgh, 18,769, or 10.7 per cent. of the total, were on Feb. 28, 1918, enrolled in the educational courses.

FIG. 2. MIXED CROWD LISTENING TO LIBERTY LOAN TALK

While a large proportion of these students outside of the language courses are naturally men and women of American birth, a considerable number of foreigners are also included in the other courses, especially such men as have mastered the language work and so fitted themselves for advancement to foremen, and are now preparing for further progress by educating themselves in some of the more technical matters relating to railroad operation.

Supplementing the correspondence courses, numerous safety lectures are conducted solely for the benefit of alien employees. To sustain interest in these efforts, and to combine entertainment with educational features, considerable time and money were spent in the preparation of a moving-picture film entitled "The Americanization of Tony."

This film depicts the career of a young Italian who comes to this country, goes to work on a railroad, develops habits of carelessness in spite of many warnings, and finally is seriously injured. He then takes his lesson to heart, develops into a model employee, becomes interested in Americanization, and finally is naturalized as a good citizen of the United States. This film has been exhibited thus far to gatherings of foreign-born employees at 80 of the principal points along the Pennsylvania Railroad System, and has carried its message to thousands of individuals.

While special efforts have been devoted to the Italians, on account of their great numbers, Americanization work has also been directed among the employees of the other foreign nationalities represented in the working forces of the Pennsylvania R.R. Broad opportunities along these lines have been, of course, presented in connection with the Liberty loans. During the offering of the first and second Liberty loans systematized campaigns were carried on among the alien workers with substantial and gratifying results. Some of the figures applying to the first loan will be sufficient to indicate the extent to which participation of the foreign-born employees was secured. A speaker addressing a crowd of mixed foreign-born workers is shown in Fig 2. At the time when the First Liberty Loan was offered to the public the Pennsylvania lines east of Pittsburgh and Erie had a total of 25,827 employees who had been born in foreign countries. Of this number 8146 employees, or almost 32 per cent. of the total foreign born, purchased Liberty bonds, and this was within 2 per cent. of the proportion of employees of American birth who subscribed.

The inquiry also brought out the interesting fact that in the service of the Pennsylvania R.R. were men of 42 different nationalities besides native-born Americans, and that members of 30 alien races were included among the buyers of Liberty bonds of the first loan.

The good showing made by employees of alien birth in Liberty-loan subscriptions may doubtless be confidently accepted as evidence of true love for America no less than as a proof of a high degree of thrift on the part of the foreign born. The latter characteristic moreover is further emphasized by the figures for the Pennsylvania Railroad Employees' Saving Fund. This fund at the present time has about 9700 depositors, and of this number approximately one-third are employees of foreign birth.

As early as 1904 the Pennsylvania R.R., with the idea of encouraging thrift among its foreign-born em-

meaning of suffering and sorrow and slavery and hunger? Do you remember the torturing ques-

ployees, opened a campaign to increase its saving-fund depositors, and as a result a great many Italian and Irish employees opened accounts in the company's saving fund, and large numbers of them are depositors today. To assist in this work a special pamphlet of information was issued in both English and Italian.

To ascertain the proportion of foreign-born employees that had been naturalized or was in process of becoming citizens a special analysis was made on June 30 last. At that time there were in the service of the Pennsylvania lines east of Pittsburgh 25,721 men of alien birth. Of this number it was found that 8003 had been fully naturalized, 3069 had taken out their first papers and 5064 had definitely announced their intention of applying for naturalization. In other words, nearly 63 per cent. of the total had either become citizens or had declared their intention of so doing.

On the lines west, out of a total number of 7500 employees of alien birth, about 1900 are naturalized, 1700 have taken first steps toward naturalization and 1300 have definitely announced their intention of applying for citizenship.

Altogether experiences on the Pennsylvania Railroad System in the effort to interest foreign-born employees in American citizenship have been encouraging. The United States must necessarily rely on people of foreign birth to keep up its labor supply if the processes of further settling and developing the country are not to come to a standstill. It is therefore a clear duty to take care of the foreigners who come to these shores, to make life worth while for them here and to safeguard them from being spoiled and degraded.

A condition approaching the ideal will have been realized when "Little Italys" and other foreign colonies disappear from American cities and when the children of immigrants, instead of being known by the nationalities of their parents, will be American boys and girls.

Tooling a Fay Automatic Lathe for a Cone Pulley

BY ALBERT L. EDDY

I was recently called upon to tool up a Fay automatic lathe for the purpose of finishing the cone pulley shown in the drawing.

As lightness was a primary consideration in the design of the cone, there was no web or arm of which advantage could be taken for driving purposes, therefore it was necessary to design a mandrel which would carry the full driving load without trouble.

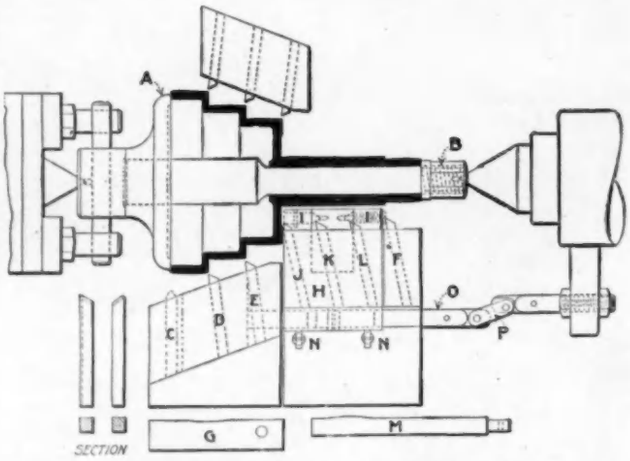
As it would have been impracticable to drive the casting against the pressure of the multiple cut by friction of the bore alone, the large disk *A* was provided to do the driving. This disk is a force fit on the body of the mandrel, and the work is firmly clamped to it by the nut *B* at the other end. A two-point drive is provided at the large end of the mandrel.

The material selected for the mandrel was "Hy-Ten" steel, "B" temper, which was heat-treated to show 80 on the scleroscope and then drawn to 350 deg. in oil. The disk, washer and nut were made from mild steel and pack-hardened.

Locating the work from the face of the driving disk insures that the facing cuts and the center of the various crowns will always come in proper relation.

The facing is done by the tools in the rear holder. The crowning is accomplished by tools *C*, *D*, *E* and *F* in the front holder, the curve of the crown being determined by the cam *G*. Part *H* is mounted upon the small centers *I*, which are below and about ¼ in. in advance of the cutting points *J*, *K* and *L*.

To make these points turn the hub parallel while the



TOOL SET-UP FOR FAY AUTOMATIC LATHE

tool holder is traveling in the curved path necessary to produce the crown, the cam *M* is provided under the front end of part *H* tending to tilt the latter in such manner that the tool points carried by it are fed forward in proper ratio to counteract the horizontally curved path of the holder itself, the resultant of these two opposed movements being a straight line of travel.

The tilting movement of this part of the tool holder is resisted by coil springs at *N*, which keeps the front end in contact with the cam *M*. This cam is held against longitudinal movement by the bar *O*, which is provided with the link *P* to accommodate necessary transverse movement of the holder.

The tools used are regular ⅜ and $\frac{7}{16}$ in. bits of high-speed steel which are first surface ground on two sides as shown by the section, the turning tools being given a clearance of 5 deg. on the cutting side and the facing tools ground square.

The rotative speed is 30 r.p.m. with a feed of 0.012 in. per revolution. The cutting time is 7.3 minutes.

tions that came to your mind at night when you thought of the fate of your helpless wife and children

Selecting the Employment Manager

By PHILIP BRASHER
Employment Manager Chile Exploration Co.

Economical production depends to a very large extent on the personnel of the working force. In turn this working force depends on the employment managers, upon whom devolve the responsibility of selecting the most capable workmen. The position of the employment manager therefore is one of vital importance to any organization.

AT THE present time when the subject of employment is so much in the public mind it would seem worth while to consider the personality of the employment manager. To anyone who has devoted thought to the question it is rather astonishing that American industry, which has spent so much effort on organizing efficient purchasing departments and testing laboratories for materials, has absolutely ignored until recently the acquisition of proper human material which after all is the backbone of any successful organization. The chart shown is used by L. O. Pethick, director of personnel of the Winchester Repeating Arms Co., and indicates the varied activities in personnel work that the employment manager should be held responsible for. The establishment by the Government of a school for employment managers at Rochester, N. Y., and the establishment of a course at New York University show that the lack of trained men in this line is at last beginning to be appreciated.

Broad Experience Necessary

It is obvious that the man whose duty is to select other men and women for a certain task must have broad experience and education to make him competent to fill his position. If it is important to have a highly paid specialist to superintend the buying of a million dollars' worth of goods yearly or to pass upon the proper design of a piece of machinery, how much more important is it that the man selected to buy a million dollars' worth of human nature in the course of a year must be properly equipped by nature and training to give the best results.

Take the training of the employment manager first. In my opinion no one can properly hire men who has not done a great deal of really laborious work himself. By this I mean actual physical labor of various kinds with his hands. A man should have had a general experience of at least ten years, and better twenty, if that is possible. He should also have a good fundamental education, and if he has a higher education so much the better; that is, if it does not result in his acquiring too many theoretical ideas which sometimes are the curse of a "college education." In addition to this the employment manager should have traveled and served an apprenticeship in different localities and, if possible, in several countries. In other words, he should have broad education and experience upon which to build before he is considered to be competent to pass judgment upon others. These considerations, I believe, make the employment manager's job an ideal one for an older man.

The responsibility of an employment manager is seldom appreciated by those who have not a clear understanding of the situation. Many times a day he has the power to make or break some individual, and this is something which should always be kept in mind. An employment office cannot be conducted as an eleemosynary institution, but a courteous reception and hearing and a suggestion as to some place where immediate employment may be secured if the services of the applicant cannot be used by the employment manager's concern are part of the modern plan. There is enlightened self-interest in this.

The Ideal Employment Manager

Now to get down to the real foundation of the matter, namely, the inherent traits and qualifications that make up the personality of the employment manager. No matter what education, no matter what experience, no matter what training he might have, unless he be the right type of man he cannot render satisfactory service. I believe—and please keep in mind that I am stating my idea of the ideal employment manager, not the one you are apt to secure, but the one you should aim to get—that he should have an unlimited stock of hard-headed common sense, which would eliminate any tendency toward the impractical no matter how splendid the underlying motive. He should be forceful, keen and courageous, because no mind can be too keen for the job, and no man who is well balanced can be too courageous to meet the incessant opposition that will be occasioned by the naturally conservative policy to be found in most old-line companies. His decisions should be made after due deliberation based on a complete knowledge of business in general and his own organization in particular. He should have the foresight to see what the result of his decisions is going to be. He should have an organizing, constructive type of mind, and these qualities will be tested by his choice of the immediate assistants upon whom he must depend for a great deal of the actual selection of employees. He

who were in the power of the beasts? How life became a succession of living deaths, every day

should be able to appreciate the commercial and financial necessities of the situation, because the first principle of business is that it should pay. He ought to be democratic, responsive, enthusiastic and persuasive, but absolutely just and conscientious. He should be sympathetic and observant, a shrewd student of human nature, with intuition highly developed. These qualities, I believe, are essential.

His experience should have taught him the general classes into which men and women naturally fall:

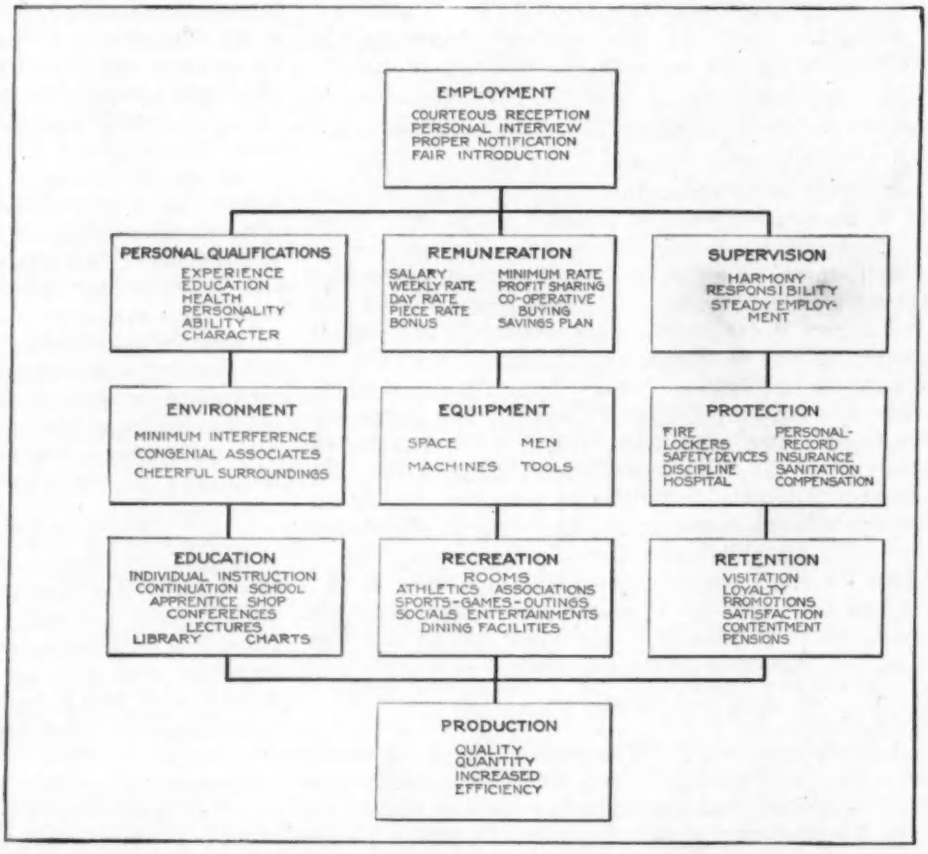
First—Organizers. Those capable of opening up new work; starting something out of routine; with plenty of initiative, etc.

Second—Administrators. Those capable of taking hold after organization has been completed and running their jobs with the maximum of conscientious care.

Third—Detail men. Those lacking qualities of leadership.

Fourth—Ineligibles. Those not suited to the organization for one reason or another.

The man who takes an organizer and places him in an administrator's position is not only incompetent in his own job, but eventually causes the one so placed to fail and possibly to fail miserably later on. Therefore his responsibility is twofold—to his employers and to those whom he places. He will always have the satisfaction of knowing that no matter how much he may improve the job will alwas remain bigger than he.



WORK OF THE EMPLOYMENT MANAGER AT THE WINCHESTER PLANT

The employment manager must know not only the work and how it should be done, but also the men in charge of the work. If, for instance, the head of a department has a prejudice against red-headed men it is wisdom to refrain from sending him any until you have won his confidence to such an extent that he would take a green-headed one if you said he would make good.

At the present time, with the demand for efficient service as great and vital as it is, it seems to me that too much thought and effort cannot be put into obtaining the proper men to select the personnel.

In conclusion, I shall quote something written by John M. Siddall which might almost be called "The Employment Manager's Creed":

"A man like Schwab, by finding and encouraging men and by inspiring their loyalty, carries himself and all his associates on to a success which none of them could achieve alone. He establishes a long battle line of organization in which there are great numbers of men intelligently used and genuinely appreciated by a commander who realizes that his own success is manifolded by the work of his associates.

"In business it is not the individual producer who gets the biggest or surest rewards. It is the organization builder. Any man, no matter how small his business, ought to recognize that fact. Unless an employer is interested in finding, training, holding and dividing with good men, the business he is engaged in can never grow. It will remain the work of one man, and the work of one man is bound to be limited in size and profits.

"You may think that you are in the shoe business or the shirt business or the furniture business; but you are mistaken. After all is said and done, we are all in the same business—the man business—no matter what we make or sell. Some of the big fellows see that point more clearly than the rest of us do, and multiply their profits and power accordingly."

bringing fresh news of the triumph of your adversary and fresh torture of mind and body until,

Shaping the Front Axle Forging On the Nash Motor Car

BY J. LEDIN
Superintendent of the Forge Department of the Nash Motors Co.

The design of a special bulldozer die for simultaneously performing several distinct operations on an automobile front-axle forging is detailed for the benefit of others who may be able to use similar methods on other classes of work.

THERE is considerable likelihood of variations occurring in the length of long drop-forgings as they come from the hammers, due to a great extent to the two ends having to be worked separately. This difficulty was found to exist in the forging for the front axle of the Nash motor car, and in order to increase or reduce, as the case might be, the length of the forging the interesting bulldozer die detailed in the illustrations was made up.

The die performs three distinct operations on this forging. The first is a straightening, or conforming, to shape; the second a length adjustment, either stretching or reducing, and the third flattens the spring-bearing pads to remove the taper which comes from the

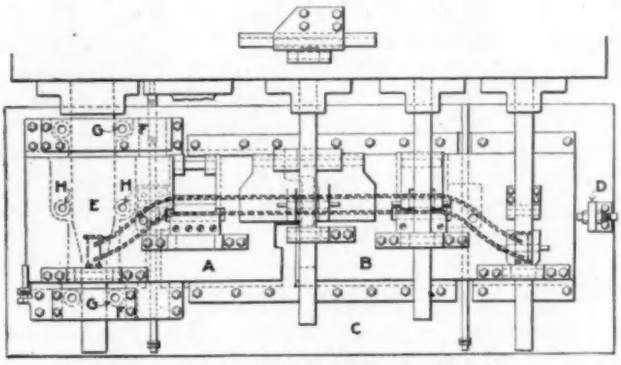


FIG. 1. ASSEMBLY OF FIXTURE

draft necessarily provided to facilitate the removal of the part from the forging dies.

This fixture was designed to operate on a No. 27 Williams & White bulldozer, and its operation on the machine is almost entirely automatic in its clamping and disengaging mechanism. The complete assembly of this fixture is shown in the illustration, Fig. 1, but as this is somewhat complicated in outline the essential parts have been detailed separately.

The two principal parts are the two die blocks *A* and *B*, Fig. 2, which are mounted to slide on the base plate *C* and clamped to it by suitable dovetailed blocks which permit either to slide longitudinally of the dies. The block *A* moves, while the block *B* is stationary, but can be adjusted within certain limits by the bracket and screw arrangement at *D* which permits compensation to be made for varying degrees of shrinkage should the steel vary from day to day. The range of movement of the block *A* permits it to correct axles of either

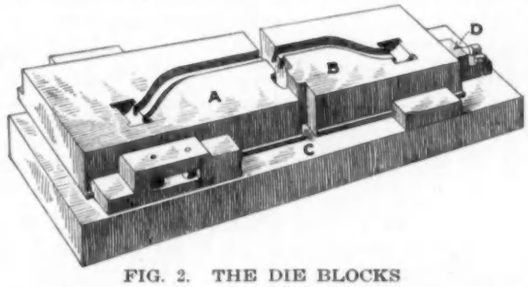


FIG. 2. THE DIE BLOCKS

1 in. over or under the correct length. Both of these dies are recessed on the top face to fit the I-form of the axle section.

Reference to Fig. 3 shows how the required motion is imparted to the movable block *A*. This is a section through this block and shows the plunger *E* which is attached to the bulldozer ram. For additional stiffness the two brackets *F* are provided on each side of the block through which the plungers pass and are guided by the rollers *G*. As the plunger advances its taper engages with the rollers *H* that are firmly held on studs through the block *A*, and by the pressure in the necessary direction lengthens or reduces the forging on the face of this block.

The straightening of the axle is accomplished by the die-face recesses in connection with the clamping arrangements necessary to hold the forging firmly in place. There are two main clamps, one at each end, which are well shown in Fig. 4. In this clamp the part *I*, which closes down on the end of the axle, is carried by and pivoted to a short lever. On this same pivot is a roller which the ram plunger *J* engages as it comes forward. The taper on the ram forces the clamp down firmly and holds it there by the lower straight face of this plunger as the remainder of the mechanism completes its stroke. To prevent the plunger *J* from springing up it passes through the bracket *K* which holds the roller *L* firmly pressing down on the upper edge of the plunger. On the return stroke when the

your spirit broken, you became what the Huns wanted you to be—a living, working corpse with

plunger *J* has freed the clamp the coil spring *M* comes into action through the small bracket on the top of the clamp and tilts it back, entirely freeing the forging so

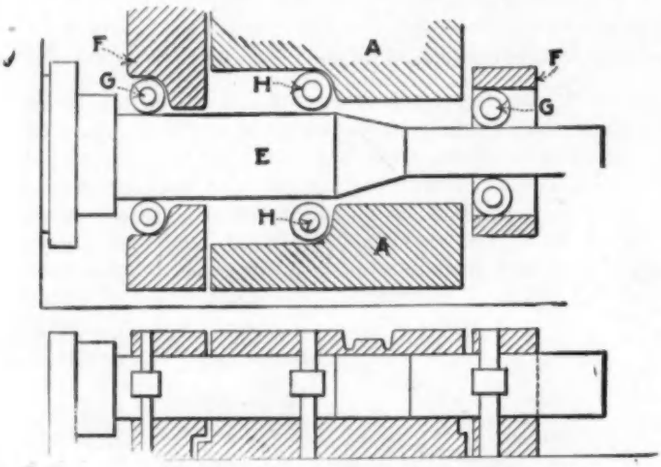


FIG. 3. HOW MOTION IS GIVEN TO BLOCKS "A"

that it may be removed without any hand work for unclamping. Small knockout pins, not detailed, under the forging at the same time partly lift it from the recess.

The lever *W* is provided to shift the block *A* one way or the other in adjusting it to the length of the rough forging so that no difficulty will occur in having it fit down into the recess. Another clamp is also provided across the center of the axle which has not been detailed.

The method of straightening up the spring pads is

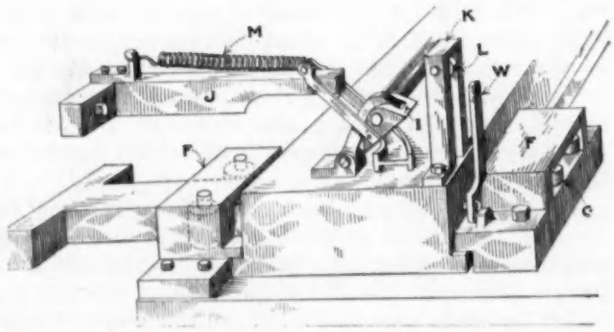


FIG. 4. THE CLAMPING ARRANGEMENT

detailed in the perspective of Fig. 5 and in the end-view section of Fig. 1. In this the upper clamp *N* and lower part *O* are hinged together so that they will close over the I-section of the axle and they have their end faces *P* planed at an angle to fit that of the inside face of the axle section after its outer face is straightened up. The sections through this pad, before and after straightening, are shown in the sections at *Q* and *R* respectively. In operation when the part *N* has been closed over an axle and the bulldozer ram advances, the plunger *S* presses down on a roller on the upper face of *N*. To prevent any springing a similar bracket to that in Fig. 4 is in this case provided at *T* with a roller to hold down the outer end of the plunger.

The clamps *N* and *O* are free to slide on the upper face of the base *C* so near the end of its forward stroke that the face of the plunger *U* comes in contact with the end of the clamps *N* and *O* and pushes them forward the required amount to completely straighten the spring pads against the face of the block *V*.

From a production standpoint the great success

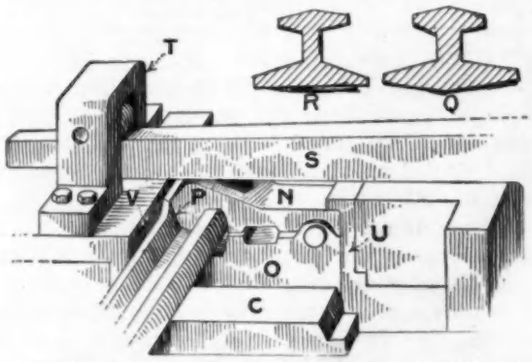


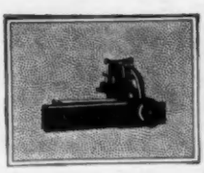
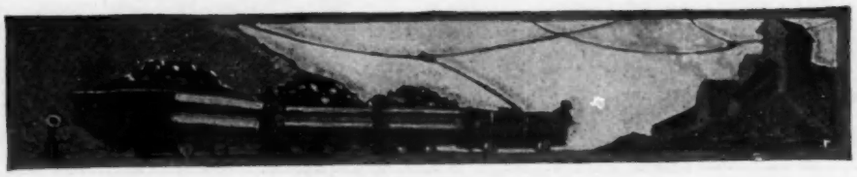
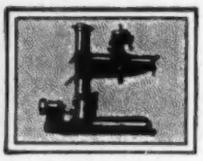
FIG. 5. METHOD OF STRAIGHTENING UP THE SPRING PADS

this die is amply demonstrated by its output of 750 axles a day, which are handled by one man and two helpers in 9 hours at a cost of $3.50 per 100 axles. The operator is on one side of the machine and one helper is on the other side to assist him. For heating the axles we designed and built a special conveying furnace. It is the duty of the third man to load the axles in one end of this furnace and remove the heated pieces from the other end by means of a long pair of tongs hanging in a chain on a trolley.

New Cleveland Section of A. S. M. E.

The American Society of Mechanical Engineers has established a section in Cleveland known as the Mechanical Section of the Cleveland Engineering Society. The petition was made jointly by members of the local and national societies in Cleveland. The section compresses Akron, Barberton, Bedford, Chardon, Cleveland, Cuyahoga Falls, East Cleveland, Elyria, Hudson, Kent, Lakewood, Lorain, Massillon, Quarryville, Ravenna, Sandusky, South Euclid, Wickliffe, Willoughby and Wooster, making a membership of about 260.

The Cleveland Engineering Society was organized in 1891 and now has a membership of 1000. The national societies of Civil Engineers, Electrical Engineers and Automotive Engineers have organized groups in Cleveland, so that coöperative opportunities are manifold.

no will except the will of your masters?——Mr. American Machine Shop Man, thank God that it

War Sparks from Industry's Forge

Edited by E.C.Porter

The Ordnance Department announces the following figures showing the production of machine guns, rifles and pistols, up to Sept. 21, 1918: Total number of machine guns of all types accepted since the war began, 146,322; total number of all types of rifles for the same period, 2,437,297; total number of pistols accepted since the war began, 221,801.

Have you Bought a Bond?

The Marine Corps headquarters in Washington desires to obtain copies of letters written by marines fighting in France for its historical records. If you have any letters from your relations or friends in this branch of the service the Marine Corps would appreciate receiving them. If you do not wish to part with the letters they will be copied and returned. No confidential matter will be recorded. The letters should be addressed to Adjutant and Inspector, Marine Corps Headquarters, Washington, D. C.

Two $50 Bonds Made One Hundre(a)d

The use of platinum for jewelry or other nonessential purposes is prohibited by regulations issued on Sept. 30 by the War Industries Board. No person, unless a manufacturer or dealer licensed by the board, may purchase or sell platinum, iridium or palladium or their compounds, or have for more than 90 days after Oct. 1 more than 1 oz. of these metals. The regulations in no way apply to jewelry already manufactured. In dentistry and other essential work users of the metals must obtain individual licenses.

U. S. Bonds or German Bondage?

Fifty per cent. of the 100,000 blind persons in the United States are needlessly so, according to information given out by the National Safety Council. Workmen are urged to wear goggles or some other form of glasses where their eyes are exposed to danger from flying splinters or particles of metal. Estimates made by the council show that about 30,000 workers are killed and about 2,000,000 injured annually in the United States. This means that one is killed every 15 min. and one is injured every 16 seconds.

It's Either the "Mun" or the Hun

Authorization to proceed with the construction of six war projects to cost approximately $2,822,150 was given to the Construction Division Oct. 1 by the War Department. The projects are as follows: Additions and extensions to the Frankford, Penn., arsenal, to cost $1,000,000; additions to the Rock Island, Ill., arsenal, estimated to cost $833,500; construction of a half-million-dollar phosphorus plant near Fairmont, W. Va.; construction of a tetryl plant at Senter, Mich., at an estimated cost of $250,000; construction of shops, warehouses, six barracks, and office building for the utilities detachment at Camp Upton, N. Y., to cost $128,650, and construction of a proving ground at Elizabethport, N. J., to cost $110,000.

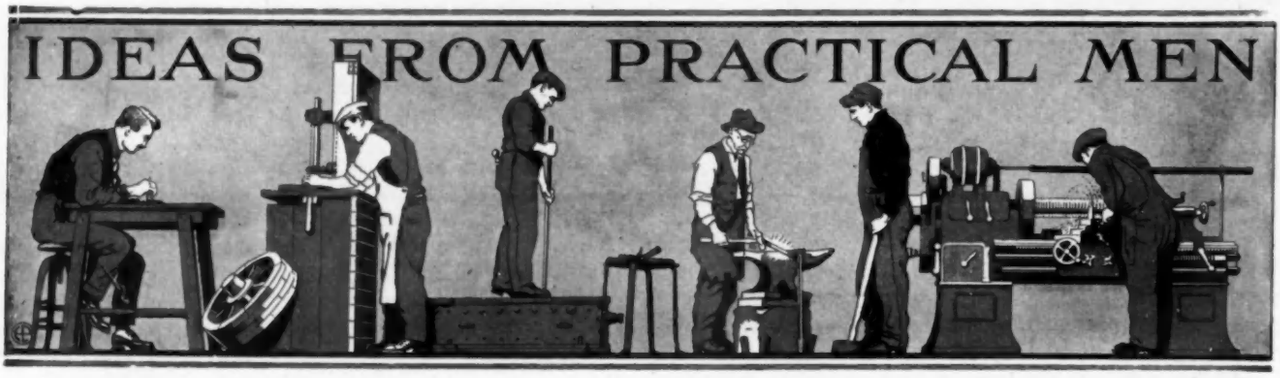
Bonds Will Knock the War "Germ" Out of Germany

The Bureau of Foreign and Domestic Commerce has received the following cablegram from G. M. Cassatt, president of the American Chamber of Commerce in London: "The directors of the American Chamber of Commerce in London passed on Aug. 29 the following resolution: This chamber agrees with the principle of the National Trademarks Bill so far as it will assist in the protection of American markets abroad, provided (1) that the mark contains no emblem or device that would be considered in foreign markets as any indication or guarantee of quality and that it shall be a mark of origin in words only and (2) that it shall be used only in combination with registered American marks."

Bonds are the Cornerstone of Liberty

Notwithstanding the practical cessation of building in all sections there still prevails a heavy demand for certain edged tools, notably auger bits, ship augers and bits, and some sizes of ship adzes. Much of the demand for these particular tools come from shipbuilding districts, but there still remains a large call for auger bits for domestic business. The supply is scant and uncertain and the scarcity very great. The demand for most other edged tools has fallen off greatly in the last 12 months. In some lines, notably planes and drawing knives, this decrease is probably permanent, owing to the work being done by planing mills which was formerly done by these hand tools. There is a veritable famine in axes and axe handles since the Government has practically commandeered the output. Crosscut saws are almost unobtainable, it again being a question of Government needs coming first. The dearth of machinists' tools, notably files and twist drills, continues unabated. This is practically true of every tool used in the machine shop.

is only in imagination that you have lived through these things. Thank God that you can go about

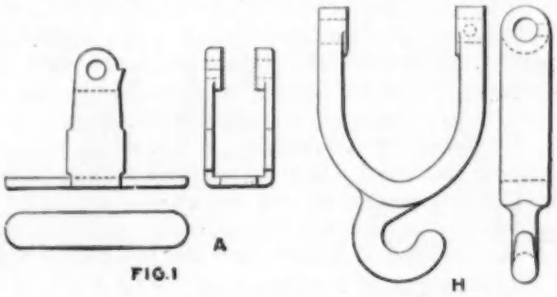


Two Special Jigs for Milling

By Christian F. Meyer

In Fig. 1 is shown a lever *A* which is required to be milled on the inner surfaces of the bosses as shown by the dotted lines.

The difficulty in performing the milling operation is due to the shape and fragility of the work, which renders it difficult to hold without springing it. Several jigs were made for this purpose before the successful one described in this article was designed.



FIGS. 1 AND 2. PARTS TO BE MILLED

The jig shown in Fig. 3 consists of a cast-iron base with two projections, or bosses, on one of which the steel plate *B* is fastened, one end of this plate being shaped into a V, as shown. Opposite this V and in line with it is a similar V formed in the end of a slide *C* operating in the other boss. This slide is moved forward and backward by means of a screw *D*. A finished surface on top of the base carries the cast-iron bracket *E*, which is so fitted that it can be fastened to the base by two capscrews which pass through slotted holes in the bracket, allowing the latter to be adjusted in relation to the work before clamping it. Two bosses upon the bracket *E* are provided with V-jaws similar to those already described. These jaws, however, instead of being rigidly attached to their respective bosses, as were the former, are arranged in such a manner that they may turn upon their axes and thus adjust themselves to any small variation from parallelism in the work. These jaws are closed by means of the screw *F* as clearly shown. The jig is used in the following manner: One of the arms of part *A* is placed between the first pair of jaws and clamped tight by the screw *D*. The bracket *E* being loose upon the base its jaws are closed upon the other arm of *A*, when the bracket will take a position determined by the shape of *A*. The floating bracket is then clamped to the base. Thus it is clear that the bracket *E* will be drawn into position to suit the shape and direction of the second arm of *A*, and the latter will be securely held without any strain or tension to cause it to spring back after the milling operation. A screw *G* is adjusted against the end of the long lower flange of *A* to prevent chattering.

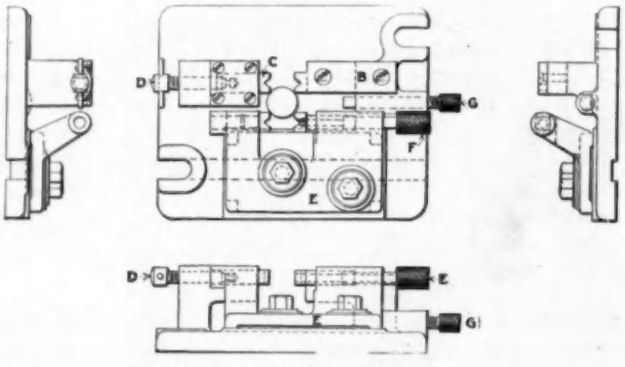


FIG. 3. JIG FOR PART "A" FIG. 1

Fig. 2 shows a holder *H* for a rope idler. The jig used to mill the bosses is shown in Fig. 4. The requirements are nearly the same as in the jig previously described, but as these holders are used in large quantities it was thought advisable to design the jig in such a way that several holders could be milled simultaneously. The jig is made for three holders and consists of a base with bracket *I* for the holding screw and three smaller arms *J* extending from *I* provided with fastening screw *K*. A top arm *L* carries a clamping screw *M* to which a hardened steel clamp *N* is fastened in such

your work without listening for the sound of guns at the gates of your city. Thank God that your

a way that it can easily adjust itself in either direction. This clamp extends over the entire width of the holders, which are laid into the jig as shown, the stationary screws *O* serving to locate them sidewise and adjust-

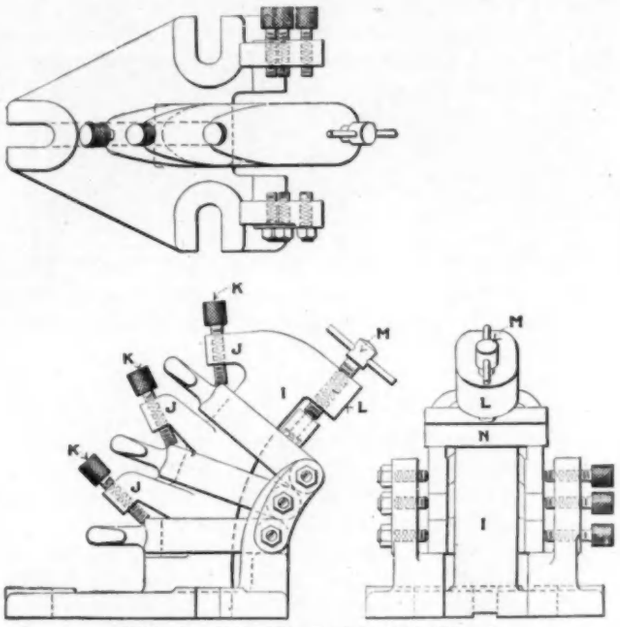


FIG. 4. JIG FOR PART "H" FIG. 2

able screws *P* are brought to bear on the opposite side. As each holder rests on three points it should be clear that they will be held firmly and without strain against each other by the pressure of the clamp. The base is cut away to allow the cutter to cut all three holders at once.

Device for Cutting Oil Grooves

BY F. C. MEYER

The device described was designed to cut oil grooves in bearings as shown in Fig. 1. These grooves were formerly cut by hand, but as the work was slow and unsatisfactory, even when done by a skilled machinist, it was necessary to provide some mechanical means of accomplishing the desired results. Not only is the production now increased 10 times but the work is done smoothly and correctly by unskilled labor. The device shown in Fig. 2 consists of a cast-iron base *A* provided with a table *B* having a transverse movement similar to the table of a milling machine. Two bearings *C* and *D*, bushed with bronze and fitted with removable caps, are bolted to the base. A cast-iron bushing, the enlarged ends of which form the bevel gear *E* and the spur gear *F*, is fitted to and revolves in the bearing *C*. The bevel gear meshes with the corresponding bevel gear *G*, which latter is mounted upon a suitable stud set in the base. Gear *G* has twice as many teeth as gear *E* so that two revolutions of the latter cause but one revolution of the former. The top of the large gear is provided with a T-slot in which slides a stud that may be clamped in any position radially to adjust the length of stroke as desired. A connecting-rod transmits a reciprocating movement to the bracket *H*, which is a sliding fit on the rod *I*, and is held in position by

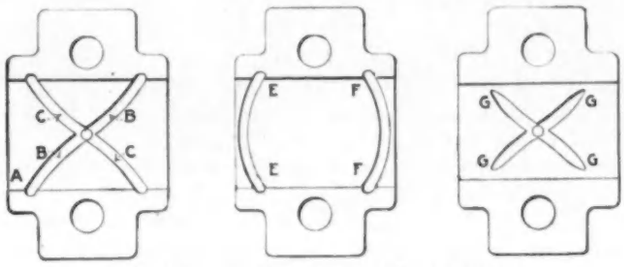


FIG. 1. EXAMPLE OF OIL GROOVING

two collars. This bracket is provided with a slotted arm sliding on the guide rod *J*, thus preventing it from turning about the rod *I*, the guide rod being held by two brackets attached to the base. The rod *I* slides easily through the bearing *D* and through the bushing which forms the gears *E* and *F*. It also slides easily through a coupling *K* which is splined to it so that coupling and rod must necessarily revolve together. A long keyway in the main rod *I* allows the latter full movement lengthwise. The coupling has clutch teeth mating with similar teeth which are cut upon the hub of the

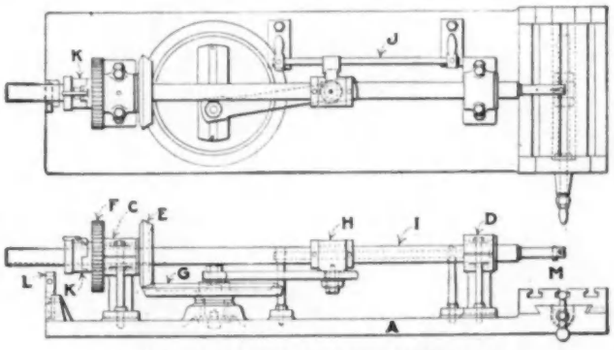
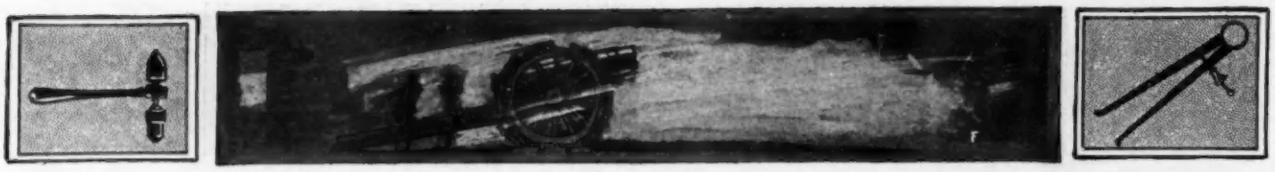


FIG. 2. THE OIL-GROOVING DEVICE

gear *F*, and it is also provided with a latch which holds the clutch in engagement.

A notch in the coupling fits over the tongue *L* in case it is desired to operate the bar lengthwise without turning it. This tongue is split and can be forced apart by a suitable screw, thus holding the coupling securely in position. The opposite end of the main rod is provided with a tapered hole into which fits a holder for the tool *M*, the cutting point of which is shaped to suit the desired oil groove.

Let us assume that a bearing is fastened to an



women and children go to sleep without the fear of death and destruction and violation coming to

angle plate upon the table in such manner that the center line of its bore coincides with the center line of the main rod. Length of stroke and location of tool are then set by adjusting the crankpin and the collars. The device is then started, and it should be clear that as the main rod is moved forward and back by the crankpin and connecting-rod it will at the same time be revolved about its axis, provided that the coupling *O* is engaged with the clutch hub of the driving gear. If the tool *R* begins to cut at point *A*, Fig. 1, it will cut along the line *B*, running out just before it reaches completion of the stroke. During the next half revolution of the gear the tool will move in the opposite direction following the line *C*, crossing *B* in the middle and coming out near the end of the return stroke. If it were possible to cut a complete bearing at once in this device, the cutter would follow the path shown at *E* and *F*. In operation the bearing is set out of center so that the tool runs out at points *G*. The cap is then fed toward the moving tool and the oil groove cut to the desired depth.

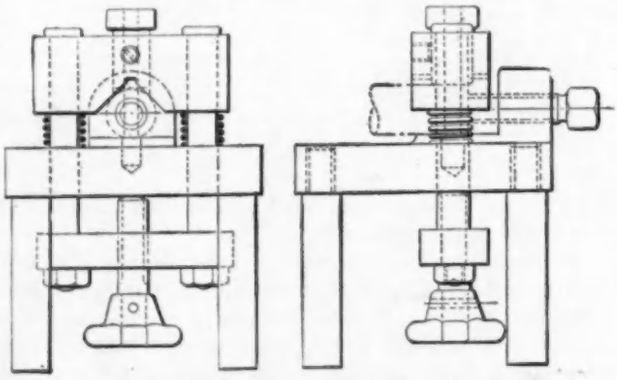
To cut a straight groove or small keyway the clutch coupling *O* is disengaged and secured to the tongue *L* as described. The advantage of this device is that oil grooves may be easily, quickly and smoothly cut into large pieces as the work is stationary. For long, small holes that are very difficult to cut by hand it will be found very convenient. Care must be taken, however, to start the cutting at the proper point in order to have the grooves intersect at the oil hole.

An Adjustable Drill Jig

By Emil E. Erbe

The sketch shows a rather unusual design of drill jig for drilling cotter-pin holes in bolts and studs.

We had an assortment of screws, bolts, studs, etc.,



AN ADJUSTABLE DRILL JIG

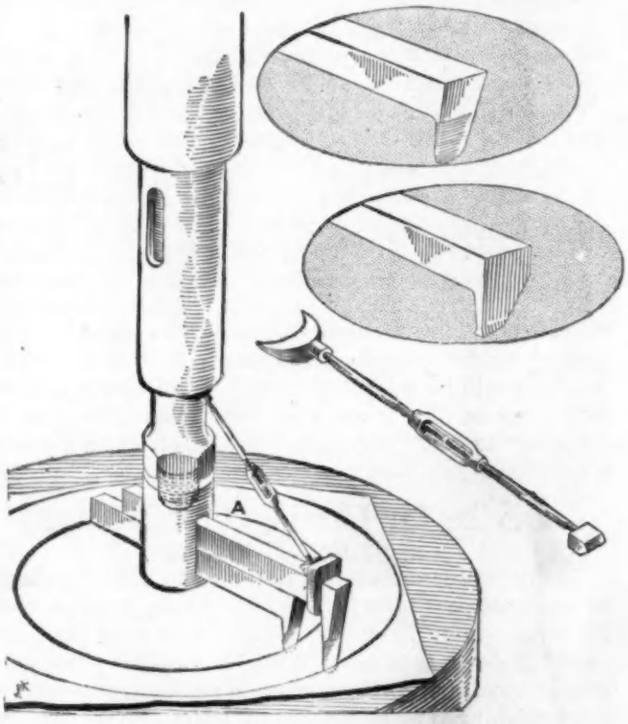
of varying lengths and diameters without sufficient quantity of any one size to warrant making jigs for each particular kind, and thus found it necessary to design one jig that would cover the whole range. All parts are made of cold-rolled steel.

The body and V-block are cyanide-hardened and the hole is lapped to take the outside diameter of bushings for different-sized drills. A headless setscrew holds the bushing in place after it is set to the proper depth. The bushing is made extra long to cover a wide range in diameters of the work and also to pilot the drill as close to the work as possible.

A Handy Gasket Cutter

By J. A. Lucas

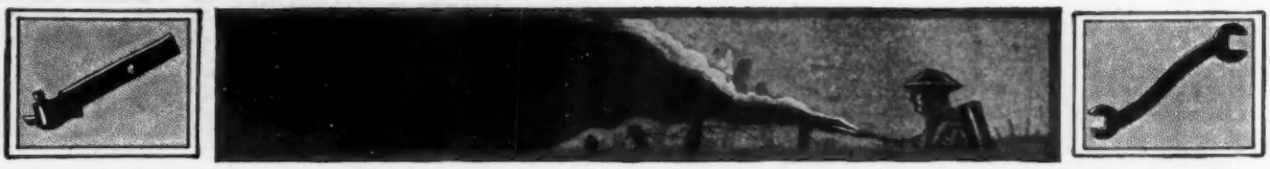
The sketch shows an inexpensively made gasket cutter that may be used to advantage in many shops. The tool may be of any size and proportion consistent



A HANDY GASKET CUTTER

with strength. With the shank fitted to a drilling machine it will quickly pay for its cost by its speed and the quality of work it will do.

This tool, with the extension support *A*, when necessary, can be used to cut gaskets from almost any material with the exception of hard metals. For soft metal the cutting tools are ground as shown at *B*. I made one while employed by the Pennsylvania and Long Island R.R. to cut fiber, asbestos, aluminum, rubber and brass, and obtained good results. To keep the edges sharp, always lay a board under the material to be cut.

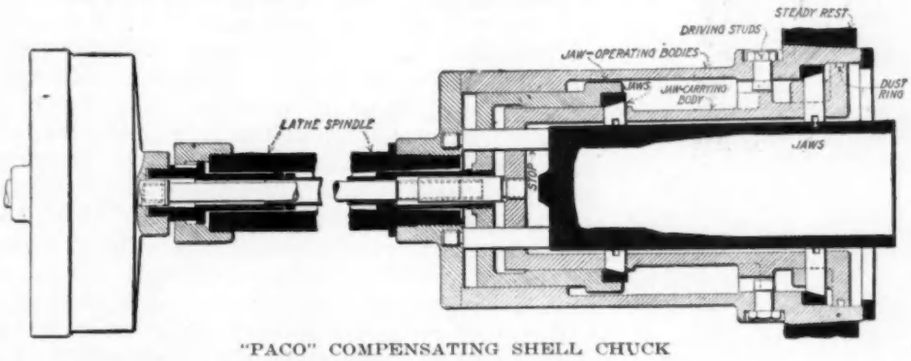


them on the midnight winds. Why in a world drenched with blood and scorched with fire have

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

"Paco" Shell Chuck

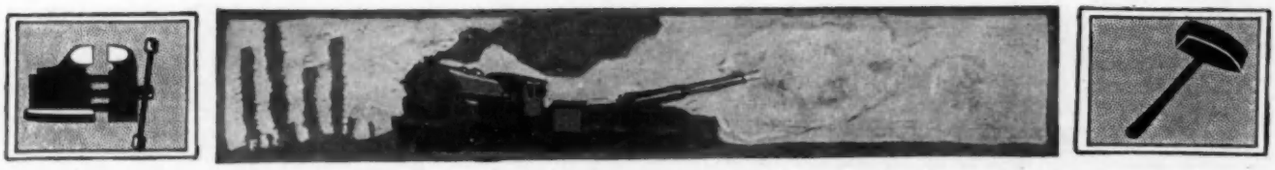
The illustration shows a cross-section of the "Paco" compensating shell chuck that has recently been placed on the market by the Production Appliances Co., 14 South Jefferson St., Chicago, Ill. Two sets of jaws are operated independently of each other, each gripping the shell at a separate point and automatically aligning it with the spindle of the lathe. It is claimed that as there is a positive connection of the jaw-carrying and jaw-operating bodies with the lathe spindle through the driving and stop studs the full power of the air is utilized for gripping the work, and hence heavy roughing cuts can be carried without unduly stressing any of the parts of the chuck. The jaws are carried by a continuous round body with apertures only for the jaws and for the studs, and the jaws disappear completely into the body when the chuck is ready to receive the shell. This, together with the dust ring, not only prevents dirt and grit from entering between the operating surfaces but also provides a chuck into which the shell can be slipped without requiring any care from the operator to avoid protruding edges or jaws. The construction is claimed to be particularly rugged.



"PACO" COMPENSATING SHELL CHUCK

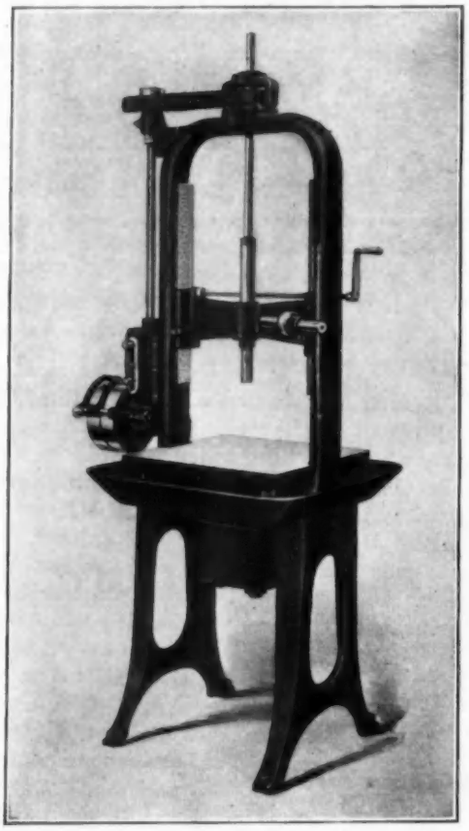
Edlund Sensitive Drilling Machine

The Edlund Machinery Co., Inc., Cortland, N. Y., has recently placed on the market the sensitive drilling machine shown in the illustration. It will be noticed that the frame is of one-piece construction, the casting being connected with an integral tie at the lower end. The cross-arm, which carries the drill spindle, is clamped at both ends and fitted with a crank for raising and lowering. It is claimed that this construction tends to give accuracy in centering, and as it prevents any spring due to an overhanging arm it is claimed to prevent drill breakage. The cross-arm is also fitted with binder clamps at both ends to hold it securely in position. An adjustable friction is employed to counterbalance the weight of the spindle and feed lever. The table is said to be extra heavy and well ribbed and is fastened to the pan at three points so that it cannot get out of alignment. The pan is of large size, is fitted with a screen and plug at the lower side, and serves as more than the ordinary trough with which the usual drilling machine is fitted, as it is provided with a pump for circulating the cutting lubricant if this is desired. The drive is through a geared speed box, a vertical shaft and a silent chain, the gears being of the sliding type. The chain sprockets are hardened, and provision is also made for taking up wear in the chain. Ball bearings are used above and below the sprockets. Four changes of spindle speed are provided, and ball bearings are used on the spindle for the thrust and upper quill bearings, while the other bearings are bronze with hardened



American homes and American shops been left unscathed? It is because from these homes and

and ground shafts. The speed-changing handles and the belt shipper are located at the left of the operator within easy reach. The machine has a clearance of 21 in. from the nose of the spindle to the table and will drill to the center of an 18-in. circle, its capacity being for



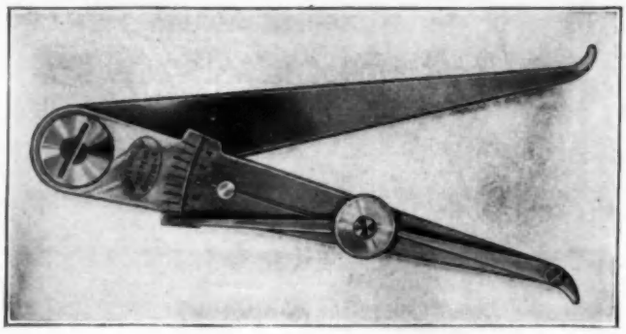
EDLUND 18-IN. SENSITIVE DRILLING MACHINE

Capacity, drills to center of 18-in. circle; maximum distance table to spindle, 21 in.; vertical adjustment of arm, 17 in.; traverse of spindle, 7½ in.; diameter of spindle, 1¾ in.; taper hole in spindle, Morse No. 2; working surface of table, 21¼ x 20 in.; diameter of driving pulley, 9 in.; face of driving pulley, 2¼ in.; size of pan, 29¼ x 28 in.; spindle speeds, 380, 660, 950 and 1215 r.p.m. with the drive pulley running at 500 r.p.m.; weight, 825 lb.; floor space, 42 x 37 in.

drills up to ¾ in. in diameter. The lever for feeding the spindle is not shown in the illustration but is mounted on the end of the shaft seen projecting from the spindle bearing.

Grove Indicating Gage

The illustration shows an indicating gage, or caliper, that is being placed on the market by the Grove Manufacturing Co., 440 Quitman St., Dayton, Ohio. The device, although having some of the features of an ordinary caliper, is used in a slightly different manner. It is first set with a micrometer, like a pair of calipers, and the position of the indicating needle for the desired setting is noted. The device is then used on the work and the difference from the micrometer setting is indicated by the pointer. Hardened points are used and the joints are lapped to fit. The indicating pointer is held



GROVE INDICATING GAGE

extended by means of the small spring shown and any difference in dimensions is magnified by means of lever arms of different lengths on the pointer.

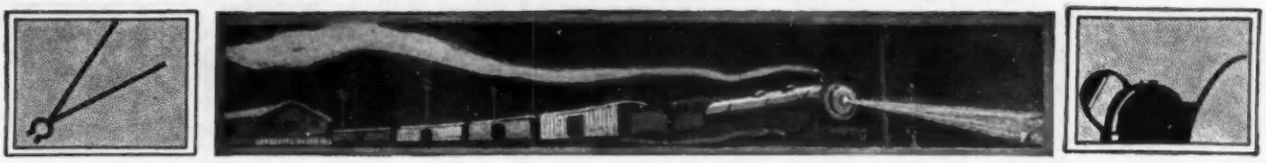
Let Us All Get Together

BY MILES C. SMITH

At one of the plants producing material for the United States Ordnance Department a department flag raising, accompanied by speech making and applause, demonstrated the spirit and enthusiasm of the men of that department in respect to the cause for which we are all fighting. That night, however, the men refused to go to work on account of a misunderstanding relative to the granting of extra pay for overtime. I heartily believe that the striking crew considered themselves fully as patriotic as when they held the celebration, yet because of their action the cause was deprived of the night's work. Surely something is wrong when a small misunderstanding can abrogate the willingness of these men to do their bit, and I can't help but feel that that something is not their lack of patriotism.

Combined with the military training of the uniformed men in service every effort is made to keep the minds of the men filled with the work in hand. They live their work every minute, and even their recreation is furnished and so planned that it will in no way divert their attention from the main issues at hand. Why cannot similar methods be employed for the army behind the army at the front?

Of the men who are employed in various plants about the country engaged in the manufacture of supplies for the army the percentage not vitally interested in the cause is so small that it can hardly be called a percentage. The principal reason for the apparent lack of interest is largely due, in my estimation, to the fact that the men are kept in virtual ignorance of their



shops must come the means of regeneration. From American shops must come the chains to bind

personal connection with events; the employers do not take their employees sufficiently into their confidence.

As an instance of what I am driving at I had occasion to talk with an employee of a plant engaged in making gun forgings, and I found that he knew scarcely anything relative to the forgings he was helping to produce other than that they were gun forgings. Fortunately I knew that one of the particular sets of forgings had been finished, assembled, proved and was at that time on its way to the front, and when I told the man of this he seemed to take a new interest in his work and to really feel that he was part of the great system to defeat autocracy. Previous to that he had never felt that he was doing other than following his trade as he had been for many years.

Why cannot we get together as the soldiers do and instill interest rather than discord in the men? Much is said and written in an offhand way relative to what is being done by the industrial army, but nothing of the get-together spirit seems prevalent in most of the shops. I don't believe 1 per cent. of the men employed in the various plants of the United States really feel that should they lay off a day or shirk their duty they are crippling our chances at the front.

We cannot all go to the war, but the support of the ones at home is of vital importance, for without it there could be no army at the front. Every effort should therefore be put forth to make the immense industrial army feel the essential nature of its part in the great struggle.

This may be effected in several ways, the posting of bulletins for one. Many plants are now engaging the service of poster companies that supply posters to be put up throughout the shop denouncing the slacker and setting forth the issues at hand. These are good but impersonal. How about putting up bulletins informing the men of the disposition of their particular products? Show them that they are really working for the cause by connecting them up with it. For instance, suppose that they are working on airplane motors, news relative to the part these motors are taking in the great struggle from day to day would interest the men, especially if some life was saved or lost through the peculiar action of a motor which they had helped to build. I am sure that the working out of this principle alone would promote efficiency and certainly would stimulate the men's interest in their work.

Another plan (though it might take some time from the working hours I am sure that it would be well spent and would be made up many times) is a short get-together meeting once or twice a week. A meeting of a half hour or so, in which someone who knew could post the men on their progress and their relation to the cause as a whole, would have a great effect on the individual interest of the employees. I have seen the effect of such meetings and I know that the facts set forth are talked over at every opportunity for many days.

Production does not mean dollars and cents at these times. It means victory or defeat, and the sooner we all realize it the quicker will victory be won.

Leander J. Hoover

Leander J. Hoover, president and general manager of the Hoover Steel Ball Co., Ann Arbor, Mich., died at his home Sept. 22. Mr. Hoover was born in 1876 and spent his early years on a farm in York County, Penn. He attended public school in Cleveland from 13 to 16 years of age, then commenced work in the shop of the Cleveland Machine Screw Co. Here he was under the instruction of John J. Grant, the father of America's steel-ball industry. He was successively with the Grant Ball Co., Grant-Hoover Co., Standard Roller Bearing Co., and

LEANDER J. HOOVER

Flanders Manufacturing Co.'s steel-ball department; afterward he organized the Hoover Steel Ball Co.

In addition to being president and general manager of the Hoover Steel Ball Co. Mr. Hoover was vice president of the Parker Manufacturing Co., president of the American Plug Co., president of the King Trailer Co., president of the Ever-Tite Nut Corporation, director of the Heath Carburetor Co., vice president of the Mulkey Salt Co. and president of the Forge Products Corporation. He was a life member of the Elks, a member of the Mystic Shrine and a life member of the Michigan Press Club.

the beast. Thank God that you are an American, and pray God that you live up to American

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Oct. 5.—Manufacturers are urged to pay careful attention to the men in their organizations who are affected by the new draft as well as those who formerly registered. All shops are bound to lose some of their men, as in no other way can the necessary quota be made up, but it is the earnest desire of the War Department to prevent as much as possible the disorganizing of industry, and every effort is being made toward this end. Everything is much better organized than it was in the first draft, but even so it is undoubtedly true that the manufacturers themselves are largely to blame for losing men who should have been retained in their shops.

In the year 1917 out of more than 3,000,000 registrants who were called, only 140,000, or 4.7 per cent., filed occupational claims. This means that over 95 per cent. of all those registered raised no question of such deferment nor were requests for their retention made by their employers. The boards do not possess superhuman faculties nor can they devote their time to searching out the men in their jurisdiction who should remain in industry. If the man himself does not clearly state his position it is up to the manufacturer to do so, and it is hoped that more careful attention will be paid to this during the present draft.

International Coöperation

As a concrete example of the coöperation that is being secured and the control that is being exercised the interallied pooling agreement reached by representatives of the United States, Great Britain, France and Italy may be studied with interest. Each country will get its needed supply of tin by what may be called an international monopoly of the beneficent sort.

This will allow the United States about 80,000 tons of pig tin, or about two-thirds of the entire annual output. The distribution will be made by the American Iron and Steel Institute, which will receive, pay for and distribute the pig tin to the industry throughout the country.

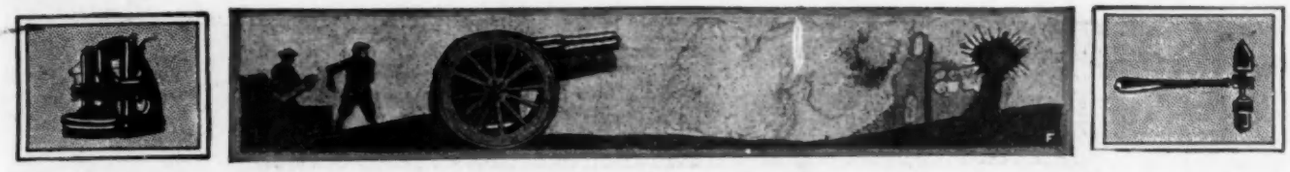
The price will be uniform to all users of 10 tons or more, with a different price, also fixed and uniform, to users of less than 10 tons. The prices, which will be fixed at what is believed to be a fair margin of profit to encourage production, will be announced later. The project is to secure a steady flow of material at a uniform price that will be fair to all instead of the fluctuating supply and prices that were the case during the past few months.

In this connection the Food Commission is working out a conservative plan by which fiber and other material may be substituted for tin as containers for food, oil, tobacco and other products.

Distributing Industry

One of the effects of the war has been to distribute industry of various kinds to different sections of the country, and it will be interesting to observe what the effects of this will be on after-the-war conditions. This distribution has introduced entirely new kinds of work into many shops, given the men new experiences and cannot fail to have broadening effects in many ways. It is not easy to say just how these experiences will fit into the conditions which are to follow the war, but it is safe to say that they will be of value in some way or other. These changes will not only involve the equipment of various shops but also the kind of work that will probably be done in the future in the different localities. In addition to this a large number of new industries, mostly of a war nature, have been established, some of which, it seems, will continue in one form or other after the war.

Along this line there is the proposal to establish a large locomotive works somewhere in the Southern states for the purpose of increasing present capacity and to do so without the necessity of adding to the congestion in those localities where plants already exist. While no definite location has been decided on it is probable that Birmingham, Ala., or its vicinity will have first choice, owing to the supply of iron and coal in this district. This would save considerable transportation, which is a great factor to be considered at the present.



responsibilities. You who have been spared the suffering and slavery—work and buy bonds to the

The one great difficulty which comes to mind in all cases of this kind is that of labor, particularly in view of its general scarcity so far as skilled personnel is concerned. Either from climatic or other reasons we have never been accustomed to consider this section an ideal one for the location of manufacturing projects; yet we must not overlook the fact that Birmingham has become a great iron and steel industrial center and that similar development may be possible in the manufacture of locomotives and railway cars.

Improving the Employment Service

One of the greatest services that the manufacturers of this country can render at the present time is to cooperate in every way possible with the various offices of the United States Employment Service. It is not expected that the service will be perfect and allowances will have to be made, bearing in mind that it is just as difficult for the employment offices to secure adequate personnel of the proper kind as for the shops to be properly manned. In fact it is more difficult because of the comparatively low salaries paid for work that should be well paid, and this in the face of the fact that men of less ability can secure higher wages in other lines.

This does not mean, however, that manufacturers should accept poor service from this new department of the Government without making protest, as criticism is one of the best methods of improving anything, provided, of course, that it is constructive and not vindictive.

There can be no question as to the necessity as well as the desirability of obtaining thoroughly capable men for handling large district offices. And this is exactly what the leading state employment directors are anxious to do, but in most cases are prevented because they cannot offer a sufficiently large salary to attract the right kind of men for this work.

There is also no question as to the necessity of having a district of this kind handled by a man of the $5000 class, and yet so far it has been impossible for the state directors to get the authority for engaging men of this kind. If the business men of the various communities will get together and demand of the United States Employment Service managers in Washington that sufficiently high-grade men be employed at the important centers they will be rendering a real service to this new department of the Government and it will do much toward straightening out the present problem of securing sufficient employees and of obtaining enough of them of the proper caliber.

There is no more important work just now than this and the one of fitting them where they belong, and it can only be done by having the right kind of supervision over the various employment districts, which means that men of sufficient ability must be employed for this work.

By endeavoring to make all criticisms of a helpful nature, and assisting the various state and district managers to secure the right kind of men for this important work, the service can be materially improved and be beneficial to all concerned.

Real Coöperation of Manufacturers

One of the cheering signs from various parts of the country is the real spirit of coöperation which is being shown among the manufacturers of different kinds of war materials. It has been my privilege to visit the offices of several shops making munitions of different kinds, and the freedom with which any information is imparted and the real spirit of helpfulness which I found was gratifying indeed. The best part of it all is that there is no camouflage about it; no hitting the high spots in showing visitors through the plants; no steering them away from certain departments or purposely avoiding special operations. Everything is genuinely free, difficulties are pointed out and blueprints of special fixtures and other devices are liberally given.

Industrial Exemption

The first duty of the industrial establishment is to bring about the needed increment of man-power in the army and the second is to protect the industrial establishments which are essential to supplying the soldiers with the tools of war. The War Industries Board directs the attention of industrial America to the fact that it has a highly important part in making the operation of the draft law successful.

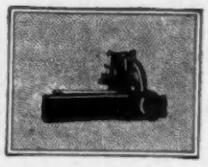
The first thing to do is for each employer of labor to thoroughly familiarize himself with the details of the law, and next to make it a matter of honor to ask for industrial exemption for the lowest possible number and only for the indispensable key men. By observing these two points the duty to the Army and its supply source will be discharged.

B. M. Baruch, Chairman.

War Department,
Office of the Provost Marshal General,
Washington, Sept. 9, 1918.

To Employers and Other Representatives of Industry:

The time has come when I must address to you some recommendations as to your share of responsibility in the classification of the new registrants under the Selective Service Act. I have noticed in the general expressions of the public attitude which reach this office two frequent features which lead me to the present comments. One of these features is the belief that the process of awarding deferred classification to a registrant requires merely the filling out of the questionnaire and that the selective-service boards will perceive the propriety of making the deferment without the assistance furnished by the registrant's formal claim indicating the deferment desired. The other feature is the employer's failure to realize his responsibility to in-



very limit, so that the beast may be chained. One hundred per cent. on the Fourth Liberty Loan!

tervene in aiding the board's determination, and therefore to inform himself fully on all the considerations which should affect the decision as to deferment. Both of these features are due to a single larger fact, viz., a failure on the part of many to reflect on the industrial considerations governing deferred classification.

1. As to the first-mentioned belief it must be pointed out that if it were universally acted upon the process of classification would be seriously hampered and delayed. Someone *must* indicate that the individual case is one which should arrest the special attention of the boards in respect to the registrant's occupational status. The boards do not possess a superhuman omniscience, nor are they permitted by circumstances to devote unlimited time to the search of questionnaires for possible grounds of claim. In 1917, out of more than 3,000,000 registrants called only 140,000 filed occupational claims, or 4.7 per cent.; thus 95 per cent of all registrants raised no question of such deferment. Under the questionnaire system the exact scrutiny of every page of this 95 per cent. of questionnaires presenting no occupational claims would have been an intolerable expenditure of time, involving a delay fatal to the speed and decisive action necessary for filling the Army.

The boards will do all that they possibly can on their own initiative to reach a just decision by a complete examination of the questionnaire even where no claim is expressly made, following in this respect the spirit of the Secretary of War's statement made before the House Committee on Military Affairs on Aug. 19 last: "It is not easily possible—it is perhaps not possible at all—to do that without some aid from the men affected; but as far as it is possible we ought to have the facts developed by the answers to the questions which the man makes and call on him for as little aid as we can in determining whether or not he is to be exempted." A registrant is therefore at liberty, if he sees fit, to trust to the scrutiny of the boards to discover the necessity for his deferment.

Nevertheless the boards will welcome and will need all the aid that can be furnished by the indication of a claim made for deferment. With this aid the process will become a simple and speedy one. Time and labor will not be wasted on needless search and ample time will be gained for thorough attention to those cases explicitly raising a question of occupational deferment.

But who is to make that claim? Ordinarily the registrant himself will indicate the claim on his questionnaire. But if through mistaken chivalry he should fail to do so, another may make it for him. In industry, agriculture or other occupations this other person will naturally be his employer or some other representative of his associated group. And this brings me to the second feature above mentioned.

2. Why should the employer or other third person in such cases make the claim? Because the employer in this situation represents the nation—because (in the statutory phrase) "the maintenance of the military establishment or of national interest during the emergency" requires that some well-advised third person should look after that national interest, which the registrant himself may not have sufficiently considered.

It is at this point that I wish to address to employers (and other representatives) the suggestion that they charge themselves more systematically than hitherto with this responsibility. I have above referred to such third persons as "well advised," and this is the place to emphasize to employers the importance of making themselves well advised for the execution of this duty.

How many employers having charge of some industrial or other occupational group have hitherto taken pains to inform themselves systematically which of their employees are registrants and which are not? How many have studied carefully the required conditions for occupational deferment as laid down in the President's regulations pursuant to the statute? How many have made it a point to survey their entire plant so as to single out the really indispensable individuals? With the oncoming of a more extensive registration an even larger outlook is necessary. The general industrial conditions, the supply of skilled men in the industry at large, the possibility of training substitutes, the availability of women workers—these are some of the considerations which bear directly on the need of occupational deferment as related to the need of the Army.

Moreover it is often forgotten that the selective draft is only one element in the depletion of a particular industry's man power. A second and a large element is found in the voluntary withdrawals for enlistment. How large this is may be seen from the circumstance that the total inductions by draft have reached some 2,000,000, while the total enlistments in the Army and the Navy amount to some 1,400,000—nearly three-quarters as many. A third element, very large, but unknown as to its precise extent, has been the transfer of labor power from one industry to another, i.e., into the distinctively war industries offering the inducement of higher wages. How relatively small in actual effect has been the effect of the selective draft is seen in the fact that for all the occupations represented in the 8,700,000 classified registrants of January, 1918, the percentage of the entire industrial population represented by the Class I registrants amounted to only 6 per cent. It ran as low as 3 per cent. for some occupations and correspondingly higher for some other occupations; but the national average was only 6 per cent. Any notably larger depletions in particular industries must therefore have been due partly to enlistments and in probably greater degree to voluntary transfers into other industries.

These other influences are therefore to be kept in mind by employers and others in weighing the question whether the best solution in the national interest is to ask for the deferment of individuals or groups of men. Such deferments may assist the immediate situation in the particular establishment; but they merely force the Army and the Navy to seek elsewhere for the same number of men thus deferred. The quantitative needs of the military forces are known and are imperative, and any given quantity of deferments will ultimately have to be made up by the depletion of some other occupation. Thus it becomes the employer's duty to consider these largest aspects of deferment in seeking that solution of his own problems which best comports with the national interests.

My present object is to urge upon employers the duty and responsibility of becoming well advised in all these matters; of equipping themselves with full information as to the extent to which their particular establishment is affected by the liability of registrants to military service; of observing the extent to which other influences of depletion have affected it, and the degree in which other methods of supply can relieve that depletion, and of laying these facts and other pertinent ones before the industrial advisers now to be placed at each district board to the end that those individuals or groups who are indispensable and irreplaceable would receive deferment, whether or not they have made claim for it, and that the Army and the Navy should not be deprived of its proper supply of man power by ill-considered deferments not absolutely demanded by the national interest.

The cessation of enlistments will henceforth protect industry against one irregular and uncontrollable source of derangement. It will correspondingly throw upon the selective-service system the greater responsibility for an intelligent and discriminating selection made in the light of industrial needs. But this responsibility is shared by employers and all who represent groups of workers. To fulfill this responsibility they must now prepare themselves even more carefully than hitherto. They will find the boards heartily ready to coöperate with them to the utmost.

The keynote of purpose for all of us ought to be, and I am sure will be, that wise and profoundly significant phrase in the act of Congress under which we operate, "the maintenance of the military establishment or the effective operation of the military forces, or the maintenance of national interest during the emergency.

E. H. CROWDER, Provost Marshal General.

Personals

Laurance H. Hart is now safety engineer of the Ferguson Steel and Iron Co., Buffalo, N. Y.

J. H. Gould, formerly of the J. H. Gould Co., Detroit, Ohio, is now chief engineer of the Buffalo Pressed Steel Co., Buffalo, N. Y.

Frank H. Ball, formerly engineer of the Penberthy Injector Co., Detroit, Mich., has been made manager of the carbureter department.

J. C. W. Smith has resigned as efficiency engineer at the Weston-Mott factories, Flint, Mich., to take the management of a munition plant at Baltimore.

Robert Mawson recently connected with the Quigley Furnace Co., New York, is now general superintendent and production manager of the ordnance department of the Mosler Safe Co., Hamilton, Ohio.

Payne G. West, formerly associated with the T. L. Smith Co., Milwaukee, Wis., has been appointed assistant manager of field sales for the Lakewood Engineering Co., Cleveland, Ohio.

E. Menke, formerly general foreman of automobile assembling at the Harroun Motors Corporation, Wayne, Mich., has been promoted to the position of motor-car production manager.

Harry Wright, who was vice president and general manager of the Stamford Rolling Mills, Stamford, Conn., is now at Buenos Aires in the interest of the American trade with the Argentine.

John E. Garient, who has been in charge of motor-car production of the Harroun Motors Corporation, Wayne, Mich., has resigned to become assistant superintendent of production in the ordnance division.

A. R. Carlson has resigned as purchasing agent of the Commonwealth Motors Co., Chicago Ill., and has joined the purchasing staff of the Wright-Martin Aircraft Corporation, New Brunswick, N. J.

J. M. Larkin has been appointed assistant to E. G. Grace, president of the Bethlehem Steel Co., and will administer the affairs of a new department created for the purpose of dealing with labor relations and associated industrial questions.

J. E. Grady, sales manager of the Studebaker Corporation of Canada, Ltd., and manager of the Detroit branch, has resigned to become associated with **R. T. Hodgkins,** vice president and general manager of the Cleveland Tractor Co., Cleveland, Ohio.

Robert H. Bachman, formerly of Allentown, Penn., who recently resigned as vice president of the Edison Storage Battery Co., West Orange, N. J., is now connected with the Wright-Martin Aircraft Corporation, Long Island City, N. Y., in an executive capacity.

Brig.-Gen. L. B. Kenyon of the British Ministry of Munitions and head of the gage and laboratories commission, has moved his office from 165 Broadway to Madison Ave. and 45th St., where two floors have been engaged for the 80 persons constituting the staff.

H. S. Ketcham has resigned as New England district sales manager for the Cleveland Tractor Co., Cleveland, Ohio, and has become the sales manager of the Southeastern and Southwestern district for the Heath Duplex division of the McCord Manufacturing Co., Inc., Detroit, Mich.

Obituary

John T. Oltrogge, vice president of the Wesel Manufacturing Co., Brooklyn, N. Y., manufacturer of printing machinery, died at his home in West Islip, L. I., on Sept. 30, 1918. Mr. Oltrogge was 65 years old.

Albert P. Weigel, president and general manager of the Weigel Machine Tool Co., Peru, Ind., died Sept. 16, 1918. Mr. Weigel was a native of Pennsylvania and at the time of his death he was 50 years, 5 months and 23 days old. He had been in business in Peru about a year, having previously been for 11 years general manager of the Superior Machine Tool Co., Kokomo, Ind., and before that for 10 years he was superintendent of the Aurora Tool Works, Aurora, Ind. Mr. Weigel was a member of the Elks Lodge, the Royal Arcanum and the T. B. A. organization.

John MacGregor died at Franconia, N. H., Aug. 31, aged 86 years. He was one of the organizers of the Akron Steam Forge Co., which for many years was a well-known Akron enterprise, and afterward became its general manager. Later the plant was removed to Muncie, Ind., and Mr. MacGregor remained in Akron becoming associated with the Webster, Clamp & Lane Machine Co., and was its president for a number of years. After the consolidation of this company with the Wellman-Seaver-Morgan Co., Cleveland, Mr. MacGregor retired from active business, though he was for some time a director in the Cleveland company.

Business Items

The Moline Plow Co., Chicago, Ill., has been sold to John Willys of the Willys-Overland Co., Toledo, Ohio, according to a recent announcement.

The F. O. Stailman Supply Co., dealer in machine tools, San Francisco, Calif., has moved from 129 First St. to a new building at First and Natoma Streets.

The American Steel Export Co. has opened a branch office at 1203 Smith Building, Seattle, Wash., for the convenience of its Pacific Coast customers. The Pacific Coast sales manager, M. R. Rosse, will be in charge of this office.

Bettcher Stamping and Manufacturing Co., Cleveland, Ohio, is the new name of the Bettcher Manufacturing Co. The change in name was made to indicate clearly the character of the company's product, which is metal stamping of all kinds.

Trade Catalogs

Circular Slide Rule and King Fraction Adder. W. G. Classon, 1157 Main St., Leominster, Mass. Circular. Pp. 2; 4½ x 6¼ in. It gives an illustration and a description of the slide rule and fraction adder.

Portable Floor Cranes and Hoists. The Canton Foundry and Machine Co., Canton, Ohio. Catalog. Pp. 34; 4 x 7¼ in. Illustrations are given showing cranes and hoists being used in various capacities in machine shops, railroad shops, granite works, sheet-metal-working plants, etc.

Shell Machinery. A. R. Williams Machinery and Supply Corporation, Buffalo, N. Y. Loose-leaf catalog. Pp. 37; 8½ x 11 in. Each page gives an illustration of the machine, its dimensions and description. Machines listed include a large and varied line that is useful in shell work.

Stock List of Used Machinery. Dup'ex Machinery Co., Cleveland, Ohio. Folder. Pp. 4; 8½ x 11 in. This folder is issued monthly and contains a list of machinery in stock. The name, number and sizes of the machines are given. This firm also deals in new machines and some of those listed are new. The folder is free to all interested in new and used machinery.

Generators for Oxygen and Hydrogen. International Oxygen Co., 115 Broadway, New York. Catalog No. 4. Pp. 24; 8½ x 11 in. It describes and illustrates the latest improved electrolytic oxyhydrogen generator of the company; gives dimensions and capacities, and presents two typical plant layouts of common capacity showing the compactness for this new Type 4-1000 unit generator.

New Publications

Engineering Drawing—By Thomas F. French. Second edition. Three hundred and twenty-nine 6 x 9-in. pages; 556 illustrations. Published by the McGraw-Hill Book Co., New York. Price $2.50.

This book has proved to be very popular with students and those interested in engineering drawing. It has already run through 10 printings in the first edition. Its use by a large number of technical schools has made it possible to obtain a certain amount of constructive criticism upon which to base the present revision. The desirability of an adequate chapter on lettering and a more extended treatment of working drawings was indicated. Other changes were also suggested and have been incorporated in the new edition, the more important of them being the new chapter on lettering with its 22 pages and 45 illustrations; a separate chapter on screw threads, bolts and fastenings; a rewritten and greatly enlarged chapter on working drawings, with 60 carefully graded problems; a new chapter on structural drawing; an extension of the scope of the chapter on architectural drawing; the addition of new problems to each chapter, with the old ones redrawn to larger size, and the addition of an appendix containing useful tables and diagrams. The book as enlarged is adapted for advanced courses in machine drawing, and the group arrangement provides an adequate series of problems for either long or short courses. Current engineering and drafting-room practice are illustrated in the figures and problems, most of which have been adapted from the industries. There is also a rather full consideration of the practical modifications of theory when applied to commercial work, with suggested treatments of many cases that are often perplexing to draftsmen. Following the introductory chapter there are others on The Selection of Instruments; The Use of Instruments; Applied Geometry; Lettering; Orthographic Projection; Developed Surfaces and Intersections; Pictorial Representation; Bolts, Screws, Keys, Rivets and Pipe; Working Drawings; Technical Sketching; The Elements of Structural Drawing; The Elements of Architectural Drawing; Map and Topographical Drawing; Duplication and Drawing for Reproduction; Shade Lines and Line Shadows; Notes on Commercial Practice; Bibliography of Allied Subjects and an Appendix.

Forthcoming Meetings

The American Society of Mechanical Engineers will hold a meeting of its Middle-western sections, including Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis, in the last mentioned city on Oct. 25 and 26. It is expected that the Indiana Engineering Society and the Indianapolis Lafayette section of the American Institute of Electrical Engineers will join in making the arrangements.

American Society of Mechanical Engineers. Monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The American Supply and Machinery Manufacturers' Association will hold a convention at the Traymore Hotel, Atlantic City, N. J., Oct. 22. The secretary of the association is F. D. Mitchell, 4106 Woolworth Building, New York.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Implement and Vehicle Association will hold its twenty-fifth annual convention in Chicago, Ill., Oct. 16, 17, 18. Headquarters will be at the Congress Hotel. It will be distinctly a war convention.

The National Machine Tool Builders' Association will hold its fall convention at the Hotel Astor, New York, Nov. 7-8.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	
No. 2X, furnace, New York	34.00	34.00	
No. 2, Chicago	33.00	33.00	
Bessemer, Pittsburgh	36.60	36.60	36.30
*Basic, Valley, furnace	32.00	32.00	33.00
No. 2X, furnace, Philadelphia	34.40	34.40	
*No. 2, Valley, furnace	33.00	33.00	33.00
No. 2, Southern Cincinnati	36.60	36.60	
Basic, Eastern Pennsylvania	32.90	32.90	45.00

*Delivered Pittsburgh $1.40 more.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York		Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.245	$4.245	$5.25	$4.17	$5.00	$4.27	$5.00
Soft steel bars	4.145	4.145	5.00	4.07	4.50	4.17	4.50
Soft steel bar shapes	4.145	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.995	4.995					
Plates, ¼ to 1 in. thick	4.495	4.495	10.00	4.42	7.00	4.25	9.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.67	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.495	6.495	10.50	6.42	8.50	6.52	10.00
*No. 26 black	4.90	6.395	6.395	10.40	6.32	8.40	6.42	9.90
*Nos. 22 and 24 black	4.85	6.345	6.345	10.35	6.27	8.35	6.37	9.85
Nos. 18 and 20 black	4.80	6.295	6.295	10.30	6.22	8.30	6.32	9.80
No. 16 blue annealed	4.45	5.695	5.695	10.20	5.62	8.70	5.72	10.20
No. 14 blue annealed	4.35	5.595	5.595	10.10	5.52	8.60	5.62	10.10
No. 10 blue annealed	4.25	5.495	5.495	10.00	5.42	8.50	5.52	10.00
*No. 28 galvanized	6.25	7.745	7.745	12.00	7.67	10.00	7.77	11.50
*No. 26 galvanized	5.95	7.445	7.445	11.70	7.37	9.70	7.32	11.20
No. 24 galvanized	5.80	7.295	7.295	11.55	7.22	9.55	7.47	11.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 12%	List plus 25%
Cleveland	List plus 11%	List plus 10%
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb. in ton lots is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.50

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, ½, ⅝, ¼, 5/16, 7/16 and No. 10	22.10 to 33.00
No. 12	
7/16, No. 14 and 9/32	
No. 18	
No. 20	

Cast-Iron Welding Rods

7/16 by 12 in. long	16.00
½ by 19 in. long	14.00
⅝ by 19 in. long	12.00
¼ by 21 in. long	12.00

Special Welding Wire*

⅛	33.00
5/32	30.00
7/32	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.14	4.07	4.17
Toe calk	5.75	4.65	4.32
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	11.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	5.00	4.75	4.77
Cold-rolled strip steel	8.50	8.25	8.57
Floor plates	6.50	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17½%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2½ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	33%	16%	43%	28%	41.1%	26.1%
3½ to 3 in. steel lap welded	15%	+3%	39%	25%	37.1%	23.1%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 10 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	26.00*	26.00	23.50
Tin in 5-ton lots	78.50	83.00	62.00
Lead	8.05	8.05	8.50
Spelter	9.75	9.50	8.50

*Government price.

ST. LOUIS

Lead	7.75	7.75	8.00
Spelter	9.50	9.25	8.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	38.00	38.00	35.00	38.00	38.00	38.00	34.00
Copper wire (carload lots)	35.00	35.00	38.50	35.00	38.00	38.00	37.00
Brass sheets	39.75	39.75	40.00	40.50	37.00	38.00	37.00
Brass pipe	46.00	46.00	43.00	42.50	46.00	44.00	42.00
Solder (half and half) (case lots)	58.00	58.00	38.25	50.50	39.50	56.00	39.75

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$37.75	$30.00
New York	34.25	35.00
Cleveland	38.50	34.00
Chicago	29.50	37.00

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	17.00	23.00	17.50	23.25
Chicago	22.00	22.50	21.50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	14.00	15.00
Chicago	15.00	17.50
Cleveland	17.125	16.00

SHOP MATERIALS AND SUPPLIES

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current 1918	New York One Yr. Ago	Cleveland Current 1918	Cleveland One Yr. Ago	Chicago
Copper, heavy and crucible	24.00	24.00	24.00	24.75	23.00
Copper, heavy and wire	22.50	23.00	23.50	24.00	23.25
Copper, light and bottoms	20.50	21.00	21.50	22.00	21.50
Lead, heavy	7.25	8.00	.....	8.00	7.35
Lead, tea	5.50	6.75	7.50	6.00	6.50
Brass, heavy	14.75	15.25	16.00	17.00	23.50
Brass, light	11.00	11.50	12.50	13.00	12.85
No. 1 yellow brass turnings	13.75	16.25	14.00	16.00	14.00
Zinc	6.50	6.00	6.50	6.00	7.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.20c.	32.20c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	41.00
Chicago	38.00	41.00
Cleveland	36.50	39.00

BABBITT METAL—Warehouse price per pound:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Best grade	95.00	70.00	93.00	69.75	96.00	70.00
Commercial	50.00	40.00	23.00	24.50	25.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
	* List plus					
Hot pressed square	$2.50*	List	$1.25	$1.65	$0.98	$2.00
Hot pressed hexagon	2.50*	List	1.05	1.50	.78	2.00
Cold punched hexagon	2.50*	List	.75	1.25	1.00	1.50
Cold punched square	2.50*	List	.75	1.25	1.00	1.50

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	50%
Cleveland	50 + 10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	30%	40+10%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+ 5%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.50 Cleveland ..... $1.00 Chicago $2.50

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $5.00 Cleveland ..... $4.00 Chicago $4.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	30%	45%	30—2%
Larger and longer up to 1 in. by 30 in.	15%	20+5%	20%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	Rivets One Year Ago	Burs Current	Burs One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	20% from list	List plus 10%	List plus 20%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	30%	45—5%	40%
Tinned	30%	45—5%	40%

Button heads, ¾ 7/8, 1 in diameter by 2 in. to 5 in. sell as follows per 100 lb.
New York..$5.65 Cleveland..$5.15 Chicago..$5.67 Pittsburgh..$4.65

Coneheads, same sizes:
New York..$5.75 Cleveland..$5.25 Chicago..$5.77 Pittsburgh..$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	51.00	42.50	39.50
Brass	42.00	40.00	44.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb. but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb. but not less than 50 lb., the advance is 2½c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 5c. should be added to the base price; and for quantities under 25 lb. the increase above base is 10c.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland Current	Cleveland One Yr. Ago	Chicago Current	Chicago One Yr Ago
100 lb.	$9.17½	$12.00	$10.60	$11.75
I. C. 107 lb.	9.42½	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.95	19.10	17.90
I. C.	214	8	19.25	19.25	19.40	18.25
I. C.	270	8	21.75	21.75	21.40	20.35
I. C.	218	12	21.75	21.75	22.60	19.25
I. C.	221	15	22.50	22.50	22.10	19.50
I. C.	226	30	23.25	23.25	22.60	20.50
I. C.	231	25	24.50	24.50	23.10	21.30
I. C.	236	30	25.75	25.75	23.60	22.25
I. C.	241	35	26.75	26.75	25.10	23.25
I. C.	246	40	28.00	28.00	25.60	24.55

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	New York One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 12¼	13¼ x 20½
Cleveland	52.00	58.00
Chicago	48.06	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.10
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$4.30
Cleveland	4.60	4.60	4.50
Chicago	4.00	4.00	3.80

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Sept. 19	Sept. 12	Sept. 5	Aug. 29	Aug. 22
Prompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	$7.00	$7.00	$7.00	$7.00	$7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Yr. Ago
Raw in barrels	$1.90	$1.23	$2.10	$1.30	$2.05	$1.37
5-gal. cans	2.00	1.33	2.25	1.40	2.25	1.37

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Year Ago Dry and In Oil
100-lb. keg	14.00	14.50	12.25	12.50	14.00	12.50
25 and 50-lb. kegs	14.25	14.75	12.50	12.75	14.25	12.25
12½-lb. keg	14.50	15.00	12.75	13.00	14.50	12.50
5-lb. cans	——	——	14.25	14.00	16.00	14.50
1-lb. cans	——	——	14.25	14.50	17.00	14.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Department, will receive bids furnishing the following metals:

Schedule No. 1959, ferrochromium, delivery South Charleston, W. Va.

Schedule No. 1960, chrome nickel, chrome, vanadium, grade C. V. steel, delivery aWshington, D. C.; hot rolled or forged nickel steel, delivery various yards; shafting steel, delivery Newport, R. I.; spring, blue finished annealed steel, delivery Washington, D. C.

Schedule No. 1961, Class AN, square, semi-finished steel, class An, heat treated steel; class H.G. semi-finished steel; class H.G. heat treated steel, delivery various yards; hull, nickel plate steel, delivery Brooklyn, N. Y.; nickel steel, delivery Pensacola, Fla.

Schedule No. 1962, spring bar sheet rolled steel, delivery various yards.

Schedule No. 5781½, 2 engine lathes, delivery Newport, R. I.

Schedule No. 5877½, grinders, pipe machines, drills, etc., delivery Chelsea, Mass.

Schedule No. 5987½, machine tools, including emery grinders, etc.

Schedule No. 6084½, woodworkers' lathe, delivery Brooklyn, N. Y.

Schedule No. 6086½, 1 plate and shape spacing table.

Schedule No. 6110½, end mills and cutters, delivery Washington, D. C.

Schedule No. 6116½, two 15 ton turning riggings for handling heavy forgings.

Schedule No. 6117½, dies and punches.

Schedule No. 6120½, 1 slotting machine, 1 oil press transformer and 1 testing transformer.

Schedule No. 6165½, pipe threading and cutting machines, delivery Charleston, S. C.

Schedule No. 6169½, 7 planers and jointers.

Schedule No. 6175½, hand tools, including punches, saws, pipe tongs and wedges, delivery Norfolk, Va.

Schedule No. 6176½, woodworkers' lathes, delivery Brooklyn, N. Y.

Schedule No. 6198½, 1 condenser, delivery f.o.b. works.

Schedule No. 6199½, rope testing machine, delivery Boston, Mass., and Mare Island (Vallejo, P. O.), Calif.

Schedule No. 6203½, 250 sounding machines, delivery South Brooklyn, N. Y.

Schedule No. 6206½, 1 drill, delivery Charleston, S. C.

Schedule No. 6234½, mills and cutters, delivery f.o.b. works.

Schedule No. 6236½, double end wire machines, delivery Washington, D. C.

Schedule No. 6238½, 1 molding machine delivery Washington, D. C.

Schedule No. 6239½, 1 molding machine, delivery Washington, D. C.

Schedule No. 6248½, 2 planers, 2 shafts and 2 bearings, delivery Charleston, S. C.

Schedule No. 6254½, 1 core-making machine and 1 core-cutting machine.

Schedule No. 6268½, machine tools, delivery Brooklyn, N. Y.

Schedule No. 6163½, punch and shear, delivery Puget Sound (Bremerton P. O.), Wash.

Schedule No. 6353½, 30 portable grinders, Puget Sound (Bremerton P. O.), Wash.

Schedule No. 6213½, key seating machine, delivery Brooklyn, N. Y.

Schedule No. 6216½, arbor presses, delivery Washington, D. C.

Schedule No. 6218½, emery grinders, delivery Washington, D. C.

Schedule No. 6244½, surface grinders, delivery Washington, D. C.

Schedule No. 5935½, miscellaneous machine tools, delivery Portsmouth, Va.

Schedule No. 6162½, universal shaping machine, delivery South Charleston, W. Va.

Schedule No. 6170½, trimming press, delivery Brooklyn, N. Y.

Schedule No. 6245½, machine tools, delivery Brooklyn, N. Y.

Schedule No. 6292½, pneumatic drills, delivery Poston, Mass.

Schedule No. 6293½, electrically driven emery grinder, delivery Washington, D. C.

Schedule No. 6297½, oil bearing and testing machine, delivery Annapolis, Md.

Schedule No. 6217½, 2 pipe threading machines, delivery Brooklyn, N. Y.

Schedule No. 6261½, 3 tool post grinders, delivery Wash., D. C.

Schedule No. 6327½, 1 motor driven emery grinder, delivery Philadelphia, Penn.

Schedule No. 6330½, 6 turret lathes, delivery Washington, D. C.

Schedule No. 6335½, 1 screw cutting lathe, delivery Jupitor, Fla.

Schedule No. 6227½, 1 commutator grinder, delivery Brooklyn, N. Y.

Schedule No. 6266½, 1 belt finishing machine, delivery Philadelphia, Penn.

Schedule No. 6338½, 2 internal grinders, delivery Newport, R. I.

Schedule No. 6341, 3 bench lathes, delivery Newport, R. I.

Schedule No. 6405½, 1 grinding machine, 1 beam scale, 1 swing saw and miscellaneous foundry tools, delivery New London, Conn.

Schedule No. 6339½, 1 screw machine, delivery Newport, R. I.

Schedule No. 6388½, miscellaneous machine tools, delivery Puget Sound, Wash.

Schedule No. 6389, 2 scraping machines, delivery Norfolk, Va., and Puget Sound, Wash.

Schedule No. 6390½, 2 sensitive drills, delivery Charleston, S. C.

Schedule No. 6393½, 1 sheet metal cutter, delivery Puget Sound, Wash.

Schedule No. 6394½, 1 drill grinder, delivery Key West, Fla.

Schedule No. 6398½, 2 grinding machines, delivery Alexandria, Va.

Schedule No. 6399½, 1 screw slotter, delivery Philadelphia, Penn.

Schedule No. 6421½, high speed miscellaneous drill delivery Newport, R. I.

Schedule No. 6429½, miscellaneous holders, tool lathe, f.o.b.

Bids will be received by the Bureau of Supplies & Accounts, Navy Dept., for furnishing machines and machine tools as follows:

Oct. 15—Schedule No. 6336½, 2 polishing and grinding machines, delivery Newport, R. I.

Schedule No. 6415½, 1 molding machine, delivery San Francisco, Calif.

Oct. 18—Schedule No. 6334½, 4 centering machines, delivery Norfolk, Va.

Schedule No. 6414½, 3 drill breast machines, delivery Wash., D. C.

Oct. 21—Schedule No. 6340½, 3 engine lathes, delivery Alexandria, Va.

The Bureau of Supplies and Accounts, Navy Department, received bids furnishing machines and machine tools as follows:

Schedule No. 5570½, Class 599, lathes, delivery Brooklyn, N. Y., from Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $1962; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., $2091, alternate $2276; Rivett Lathe and Grinder Co., Brighton (Boston P. O.), Mass., $2140.

Schedule No. 5615½, Class 594, milling machine, delivery Newport, R. I., from Brown & Sharpe, Promenade St., Providence, R. I., $2339; Fairbanks Co., Colorado Bldg., Washington, D. C., $3378; H. Prentiss & Co., 149 Broadway, New York City, $3040.

Schedule No. 5690½, Class 644, traveling head planers, delivery Norfolk Va., from Motor Manufacturing Co., Muskegon, Mich., $45,300, alternate $50,700 f.o.b.

Schedule No. 5692½, Class 648, drilling machines, from Niles Bement Pond, 111 Broadway, New York City, $48,430.

Schedule No. 5693½, Class 651, radial drill, delivery South Charleston, W. Va., from American Tool Works Co., Pearl St. and Eggleston Ave., Cincinnati, Ohio, $5481; Brown & Zortman Machine Co., 2535 Liberty St., Pittsburgh, Penn., $5602; Niles Bement Pond, 111 Broadway, New York City, $5485.

Schedule No. 5722½, Class 829, metal planer, delivery Puget Sound (Bremerton P. O.), Wash., from W. F. Davis Machine Tool Co., Inc., 945 Pennsylvania Ave., Washington, D. C., $5635; Niles Bement Pond, 111 Broadway, New York City, $5600, alternate $5015.

Schedule No. 5744½, Class 544, steel drills, delivery Washington, D. C., from L. C. Blancke Co., 10 Thomas St., New York City, $25,555; Cleveland Twist Drill Co., Lakeside Ave., Cleveland, Ohio, $35,509; Detroit Twist Drill Co., 634-66 West Fort St., Detroit, Mich., $55,338; Lincoln Twist Drill Co., Taunton, Mass.; Latrobe Tool Co., Latrobe, Penn., $19,076, part bid; McCarthy Drill & Tool Corporation, 30 Church St., New York City, $12,602, part bid; National Twist Drill and Tool Co., 30 Church St., New York City, $35,654; Rich Steel Products Co., Springfield Pl., Battle Creek, Mich., $30,017; Union Twist Drill Co., 70 Munroe St., Athol, Mass., $35,584; Whitman & Barnes Manufacturing Co., Buchtel Ave., Akron, Ohio, $34,176; Buckeye Twist Drill Co., Alliance, Ohio, $35,548.

Schedule No. 5815½, Class 783 and Class 784, stud threading machine, delivery Puget Sound (Bremerton P. O.), Wash., from National Acme Co., 7500 Stanton Ave., Cleveland, Ohio, (783) $710; (784) $970.

Schedule No. 5864½, Class 752, bench lathe, delivery Norfolk, Va., from Elgin Tool Works, Elgin, Ill., $408, alternate $447; Fairbanks Co., Colorado Bldg., Washington, D. C., $509; Rivett Lathe and Grinder Co., Brighton (Boston P. O.), Mass., $1197.

Schedule No. 5923½, Class 772, core machine oven and tumbling machine, delivery Pensacola, Fla., from Federal Foundry Supply Co., 2639 East 79th St., Cleveland, Ohio, $605, part bid; Monarch Machinery Co., 300 North 3rd St., Philadelphia, Penn., $600, part bid; J. W. Paxson Co., 1021 North Delaware Ave., $1269; W. W. Sly Manufacturing Co., 4700 Train Ave., Cleveland, Ohio, $353, part bid; Whiting Foundry Equipment Co., Harvey, Ill., $412, part bid.

Schedule No. 5942½, cutting machine, delivery South Charleston, W. Va., from Newton Machine Tool Works, Inc., 23rd and Vine St., Philadelphia, Penn., $5317.

Schedule No. 5954½, Class 823, knife grinding machine, delivery Washington, D. C., from J. A. Fay & Egan, John and Front St., Cincinnati, Ohio, $602 alternate $1008; Machinery Co. of America, Bay Rapids, Mich., $539.